

# MACHINERY

APRIL 12, 1961

ONE SHILLING & THREEPENCE

**NON-  
STAINING  
SULPHURISED  
OILS**

**FLETCHER  
MILLER**

*cutting  
fluids*

**FOR  
EVERY  
OPERATION**

**E.P.  
CHLORINE  
ACTIVATED  
OILS**

**OIL-  
FREE  
GRINDING  
FLUIDS**

**FLETCHER  
MILLER  
LTD.**

**HYDE  
CHESHIRE**

Telephone: Hyde 3471

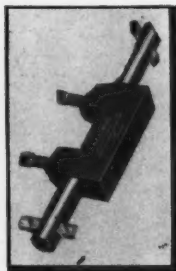
for cutting efficiency



**Eclipse**

## tool bits, lathe tools and tool holders

"Eclipse" tool holders are manufactured with the utmost care from high quality materials, are carefully heat treated and incorporate a number of special features which enable them to do their job superbly well. To complete the list of tools for turning and metal cutting, there is also the extensive range of "Eclipse" tool bits and lathe tools. Made from "Eclipse" H3 Cobalt High Speed Steel, these tools are carefully heat treated to give the perfect combination of hardness and toughness—tools which can be relied upon to maintain a keen cutting edge.



MADE BY

James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors

**There's  
over  
40 years'  
experience  
behind each**

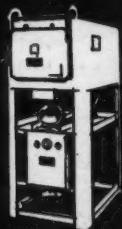


**furnace**

It takes a lot to match up to the skill and experience gathered in 40 years of furnace manufacture—forty years of design and development.

No wonder then that Wild-Barfield furnaces—whether standard or non-standard equipment—are specified by many of the leading organisations in the country.

Horizontal  
General Purpose  
Furnace  
Model H-W1



Electrode Salt Bath, Model ESB 67



Tailroom  
Tempering Furnace  
Model TRT1010



**There are standard Wild-Barfield Furnaces  
for all heat treatment purposes**

**WILD-BARFIELD ELECTRIC FURNACES LIMITED**  
ELEC-FURN WORKS · OTTERSPOOL WAY · WATFORD BY-PASS, WATFORD · HERTS · Telephone: Watford 26091 (8 lines)

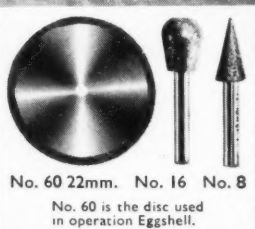
*When answering advertisements kindly mention MACHINERY.*



## cackle-shell heroes...

Even the little lion could hardly believe his eyes. But there it was—a specially designed diamond tool neatly cutting out a triangle of egg-shell, **without so much as damaging the membrane underneath!**

The chaps who designed this amazing little tool—the Cackle-shell Heroes in our back room—just revel in these “impossible” problems. May they take a look at yours?



PRECISION TOOLS LTD.

105 BOLSOVER STREET, LONDON, W.1. Tel: MUSEUM 1911/3576

*When answering advertisements kindly mention MACHINERY.*

# VERBODEN

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April 12, 1961

MACHINERY

3

# There is a connection...

**BETWEEN THESE RODS**

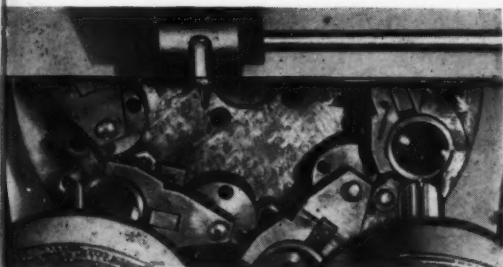
— **BOTH ARE BORED TO  
EXACTING STANDARDS**

the **PRECIMAX**  
way

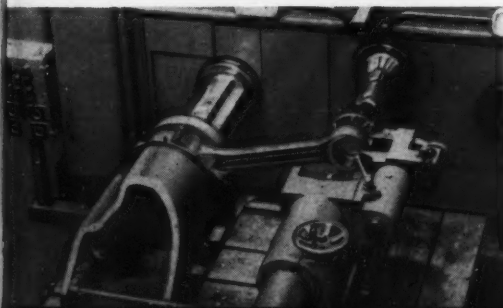
Cast iron. Weight 6 oz.



Single Ended Fine Boring Machines  
finish bore these workpieces to exacting  
tolerances of roundness and parallelism  
each end.



6 oz. model for  
L. Sterne & Co.  
at 120 hourly.



370 lb. version for  
Ruston & Hornsby  
takes 13 min. each.

45 ton  
tensile.  
Weight  
370 lb.



**LANDIS LUND LIMITED**

CROSSHILLS-KEIGHLEY-YORKSHIRE

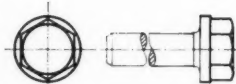
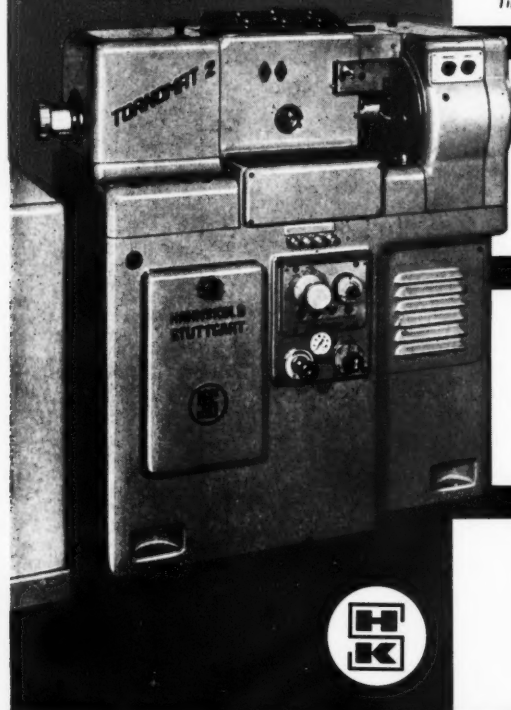
## TORNOMAT

**Polygonal Shape Turning Machines for fully and semi-automatic operation**

enabling two parallel faces, square and hexagonal shapes to be economically produced as well as slotting, chamfering and drilling operations to be performed at the same time.

### Working range

Hexagon across flats 0.118-1.417 in.  
Square across flats 0.118-0.944 in.  
Maximum turning length 1.574 in.



Across flats = 1.023 in.  
Time per piece... 20 seconds



Across flats = 0.944 in.  
Material: Mild steel, approx. 130 lbs/sq. in.  
Time per piece... 8 seconds



Across flats = 0.748 in.  
Material: Mild steel.  
Time per piece... 15 seconds



Length = 0.314 in.  
Material: Heat treated steel (CK-45),  
approx. 200 lbs/sq. in.  
Time per piece... 15 seconds



Across flats = 0.944 in.  
Material: Steel (C-35)  
Time per piece... 11 seconds

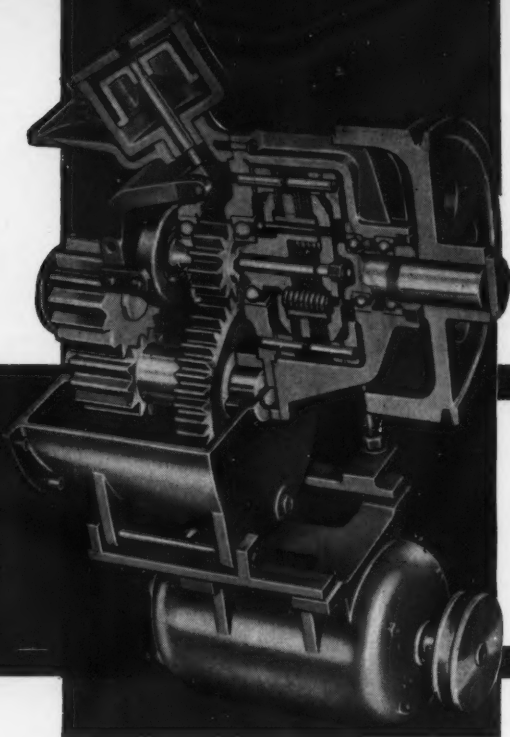
**HAHN & KOLB (GREAT BRITAIN) LTD.**  
243-245 HORN LANE, ACTON, LONDON W 3

To be demonstrated at our Private Exhibition at the Engineering Centre,  
Stephenson Place, Birmingham 2, from 24 April to 3rd May 1961

*When answering advertisements kindly mention MACHINERY.*







**Press**  
**DOWN-TIME**  
**CUT from days**  
**to minutes...**

with this *Unique*  
**INTERCHANGEABLE**  
**DRIVE**

# *New* **BRITISH CLEARING** **TORC-PAC** **AIR CLUTCH INCLINABLES**

These new look inclinables have been designed around the revolutionary TORC-PAC sealed-in-oil drive unit which never requires adjustment. Clutch and brake maintenance is eliminated by the permanently adjusted sintered bronze friction plates. TORC-PAC drives are completely interchangeable and replacement service units which are available from stock can be fitted in less than an hour.

## **DRIVE UNIT GUARANTEED FOR 18 MONTHS**

MOTOR, STEEL FLYWHEEL AND  
 TORC-PAC DRIVE ENTIRELY  
 WITHIN PRESS FRAME

CENTRALISED OIL LUBRICATION  
 ECCENTRIC SHAFT DRIVE

WELDED STEEL FRAMES GIVE  
 BIG VARIETY OF SIZES

INCLINING ADJUSTMENT BY  
 SINGLE SCREW

MINIMUM FLOOR SPACE

22, 32 & 45 TON MODELS



**ROCKWELL**  
 MACHINE TOOL CO. LTD.

Built by **VICKERS**

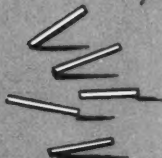
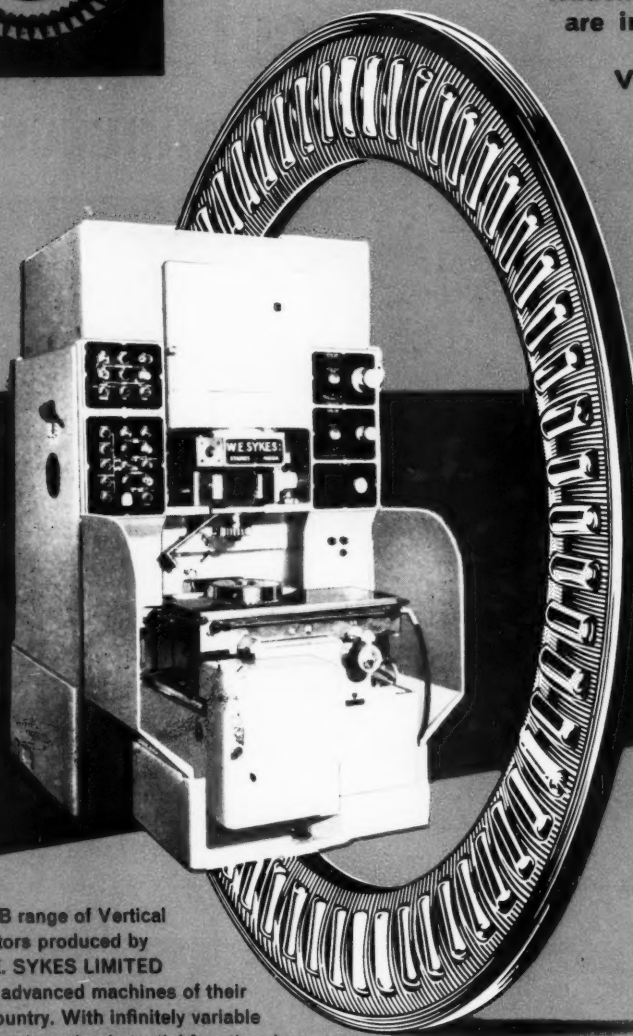
WELSH HARP, EDGWARE RD., LONDON, N.W.2. TEL: GLADSTONE 0033

ALSO AT BIRMINGHAM - TEL: SPRINGFIELD 1134/5 • STOCKPORT - TEL: STOCKPORT 5241 • GLASGOW - TEL: MERRYLEE 2022



# CHOOSE NADELLA

Nadella Needle Bearings  
are incorporated in the new  
V10B range of  
**VERTICAL GEAR  
GENERATORS**



The new V10B range of Vertical Gear Generators produced by Messrs. W. E. SYKES LIMITED are the most advanced machines of their kind in the country. With infinitely variable speeds and feeds and substantial functional improvements, these robust production machines are engineered for high performance and reliability. NADELLA NEEDLE BEARINGS offer the modern designer many advantages, including:—  
high load and speed capacity • rigidity of assemblies • light weight  
minimum space requirements • long service life • low cost

**first and foremost in needle bearings**

# NADELLA



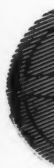
Nadella Needle Bearing Company

Factories at Ruell-Malmaison and Vierzon, France, and Bienne, Switzerland

U.K. Sales and Technical Service:

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April 1



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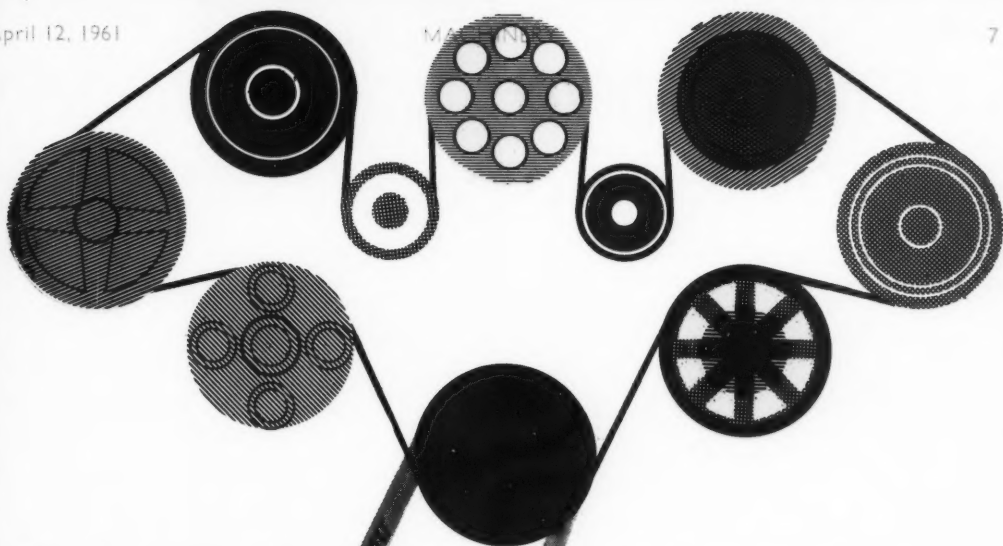


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## THE SWING IS TO DIXYLON...



*The modern synthetic belting for transmission, conveyors, printing machine tapes, textile spindle tapes, etc.*

### DIXYLON TRANSMISSION BELTING

Precision Belting for high speed drives in Machine Tool, Woodworking and many other industries.

Available in three grades—Standard, Suplex (oil-resisting), Anti Static—to solve all problems.

### DIXYLON CONVEYORS & TAPES

Conveyor Belting, available in many finishes to suit each application in food and packaging, electronic, tile making industries, etc.

- DIXYLON** ★ Light with exceptional strength.  
 ★ Flexible without internal strain.  
 ★ Easily made endless on site with simple tools—no fasteners.  
 ★ Stretchless, silent.  
 ★ Resistant to oil and chemicals.

FOR FURTHER INFORMATION PLEASE QUOTE REF. NO. DX/7

## R. & J. DICK LTD.

HEAD OFFICE & FACTORY  
GREENHEAD WORKS, GLASGOW S.E.

Telephone: BRIdgeton 2344 (5 lines) Telegrams: "Guttapercha" Glasgow.



### UNITED KINGDOM

FACTORIES: Glasgow, Leeds, Blackburn.

BRANCHES: Glasgow, London, Leeds, Birmingham, Manchester, Bristol, Newcastle, Dundee, Belfast.

### OVERSEAS

FACTORIES: Totowa, New Jersey; Muscatine, Iowa, U.S.A.

BRANCHES: Dublin, Amsterdam, Vienna.

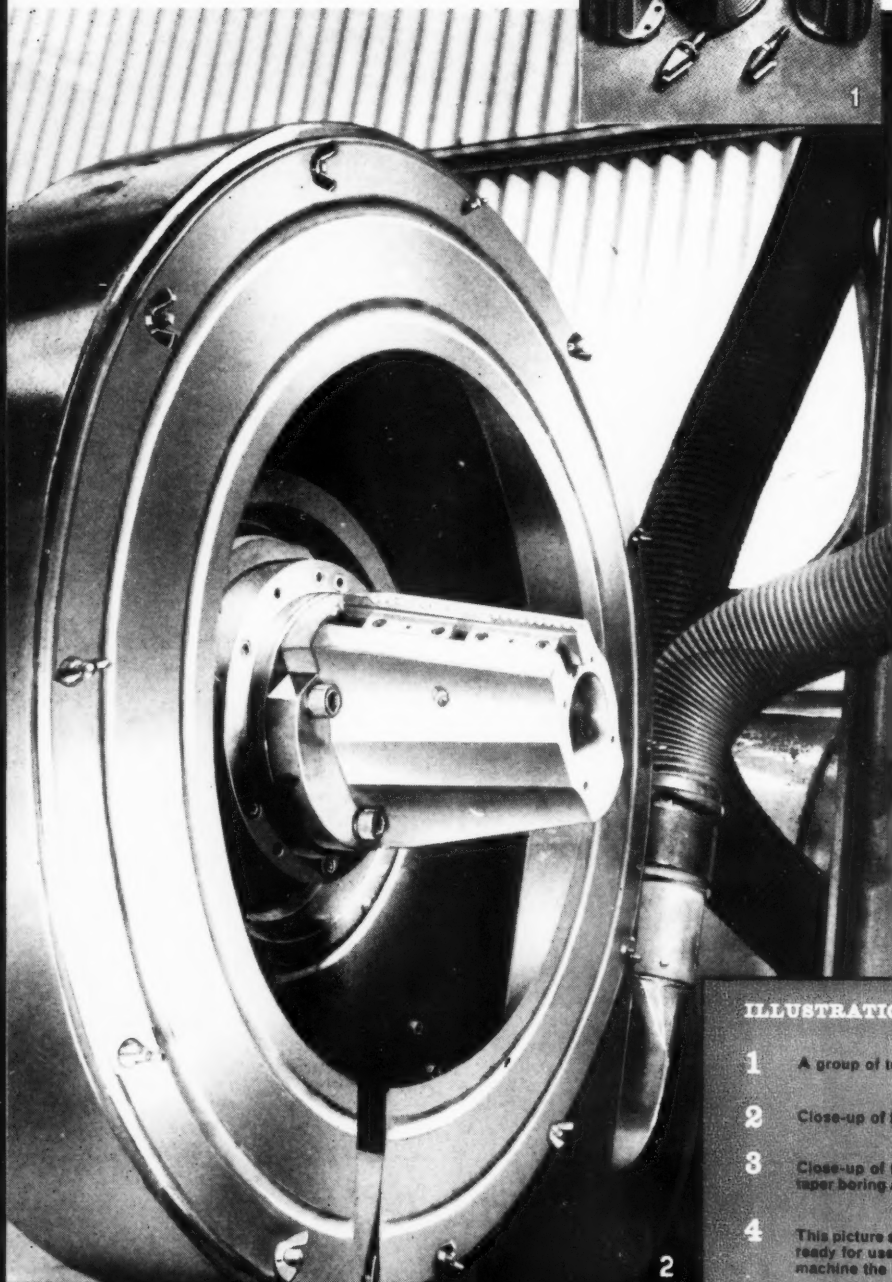
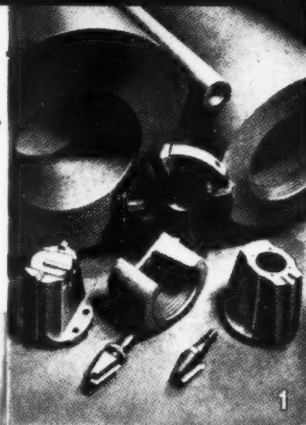
CANADIAN SUBSIDIARY: Burlington, Ontario.

**THE NAME WHICH MEANS DEVELOPMENT IN POWER TRANSMISSION**

Agencies throughout the Commonwealth and U.S.A.

# TAPER BORING

and



## ILLUSTRATIONS

- 1 A group of tools and components.
- 2 Close-up of thread milling cutter.
- 3 Close-up of tools on machine for taper boring and facing operation.
- 4 This picture shows the two machines ready for use—on the right hand machine the component is shown.



THE HISTORY OF THE  
CATHOLIC CHURCH

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# THREAD MILLING GRAPHITE ELECTRODES at

ANGLO GREAT LAKES  
CORPORATION Ltd.  
with specially designed

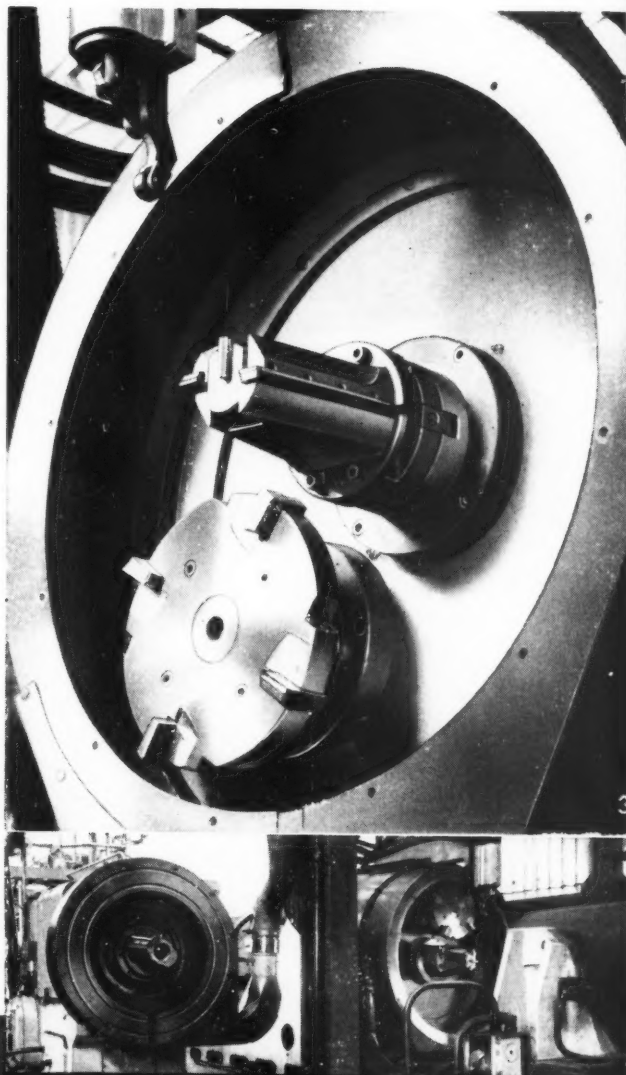
**Galtona**

## INSERTED BLADE TAPER BORING, FACING AND THREAD MILLING CUTTERS

We illustrate one set of a range of tools supplied for milling graphite electrodes. The facing head shown on Fig. 3 has standard Galtona type serrated blades, carbide tipped, whilst the taper boring cutter has tipped blades held by means of wedges and screws, with one blade cutting to centre.

At Fig. 2 we show a thread milling cutter, having one blade in T.15 high speed steel secured by wedges and screws, with fine adjustment to facilitate setting-up.

We welcome enquiries for all types of inserted blade cutters, for which proposal drawings are submitted without obligation.

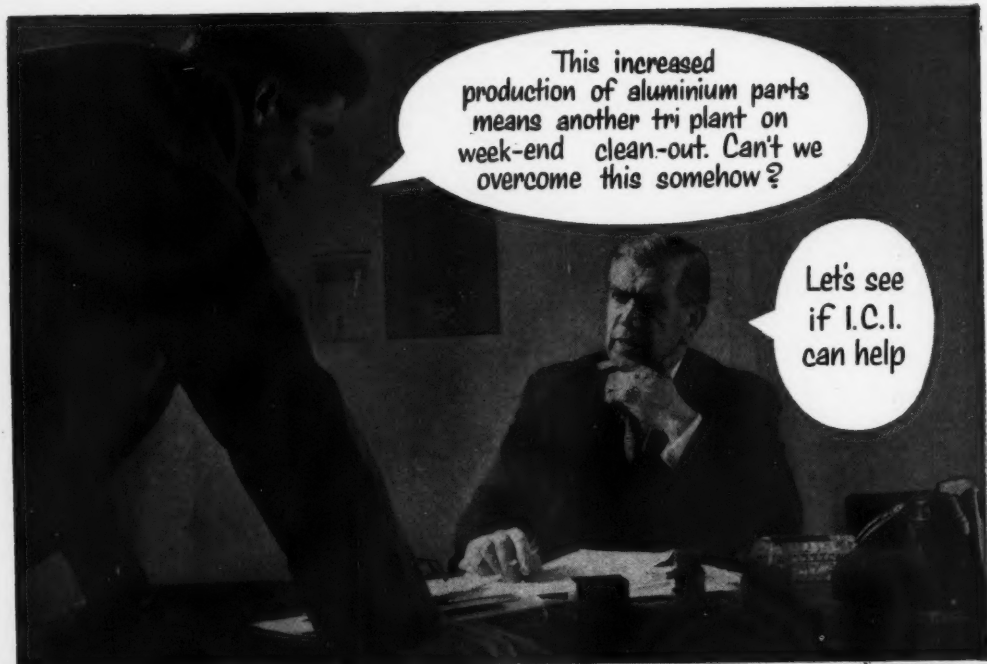


## RICHARD LLOYD LIMITED

GALTON HOUSE, ELMFIELD AVENUE, TYBURN, BIRMINGHAM, 24

Telephone: Ashfield 1801. Telegrams "Cogs, Birmingham"

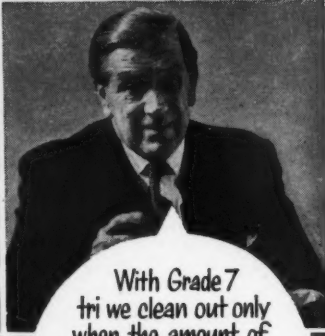
NORTHERN AREA OFFICE: Britannia House, Wellington Street, Leeds, 1. Phone: Leeds 31212  
LONDON AREA OFFICE: 240 Romford Road, Forest Gate, London, E7. Phone: MARYland 7304-5  
NORTHERN IRELAND: Garage & Engineering Supplies Ltd., 78 Great Victoria Street, Belfast.



I.C.I.'s rep. told us about a new I.C.I. solvent—Grade 7 trichloroethylene—that gives excellent protection against aluminium reaction.



We decided to tackle our problem by putting all plants dealing with aluminium on Grade 7 tri—which would mean less frequent clean-outs.



With Grade 7 tri we clean out only when the amount of aluminium swarf makes it necessary—which gives weeks of continuous running. Ask I.C.I. for Grade 7 trichloroethylene if you are worried about degreasing aluminium.



GENERAL  
CHEMICALS  
DIVISION

It pays to consult I.C.I. Metal Degreasing Service

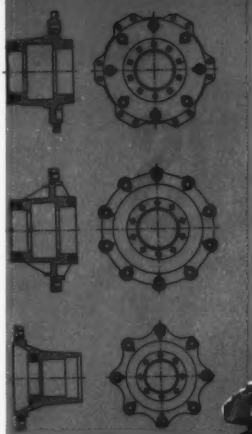
IMPERIAL CHEMICAL INDUSTRIES LIMITED LONDON SW1

DP.267

April 12, 1961

MACHINERY

KARL HULLER GMBH. LUDWIGSBURG/GERMANY



## Linked Machine Line

5 universal joint spindle drilling machines GBV 15  
1 universal joint spindle drilling machine GBV 30  
with a total of 132 working spindles

**for machining 16 various types of wheel hubs**  
with different hole patterns  
and following working operations:

**Drilling, counterboring, chamfering and tapping**  
total power requirements 110 KW  
total length of the line 14 m  
total weight appr. 65,000 kg

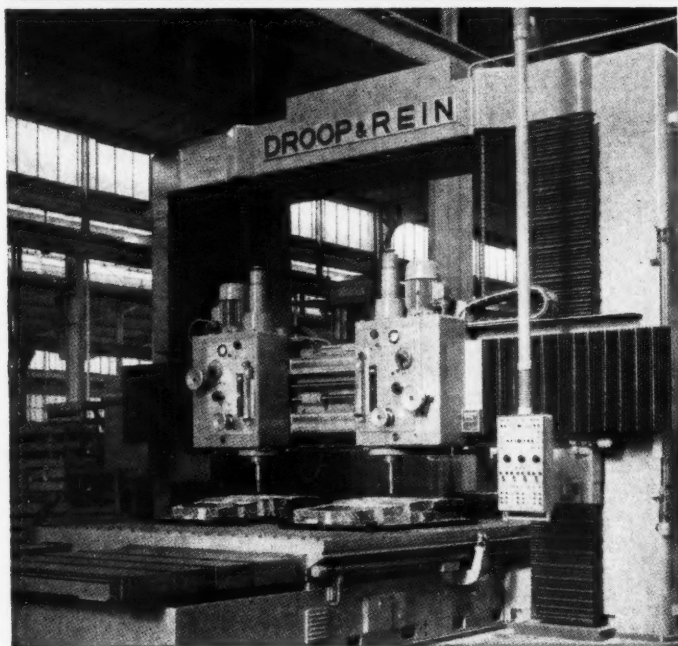
## Bishop, Eaves & Sons, Ltd.

868, Alum Rock Road

Telephone: East 4071

# ROTAX BALL SCREWS SPECIFIED BY DROOP & REIN

THE MOST ADVANCED RECIRCULATING BALL THREADS USED IN INDUSTRY



This Droop and Rein double planomilling machine is probably one of the largest in the world and Rotax ball screws are incorporated to move the cross-rail which weighs over 20 tons. Rotax ball screws meet this demand with an efficiency of over 90% and have great resistance to wear. Made of special stabilised materials they give longer life, greater accuracy and reduce maintenance costs.

Rotax Ball Screws are used wherever a highly efficient transfer of rotary to linear movement, or vice versa, is required. An impressive range of shaft lengths from 2 inches to 25 feet is available with a variety of pitch circle diameters and leads to suit your particular need.

Rotax Designers and Engineers are available to assist with your problems on a world-wide basis.

PLEASE WRITE OR TELEPHONE — THE COMMERCIAL MANAGER

## ROTAX

**INDUSTRIAL GROUP, ROTAX LIMITED**

WILLESDEN JUNCTION, LONDON, N.W.10. (ELGar 7777)

LUCAS-ROTAX (AUSTRALIA) PTY. LTD., Melbourne and Sydney, Australia.

LUCAS-ROTAX LTD., Toronto, Montreal and Vancouver, Canada.

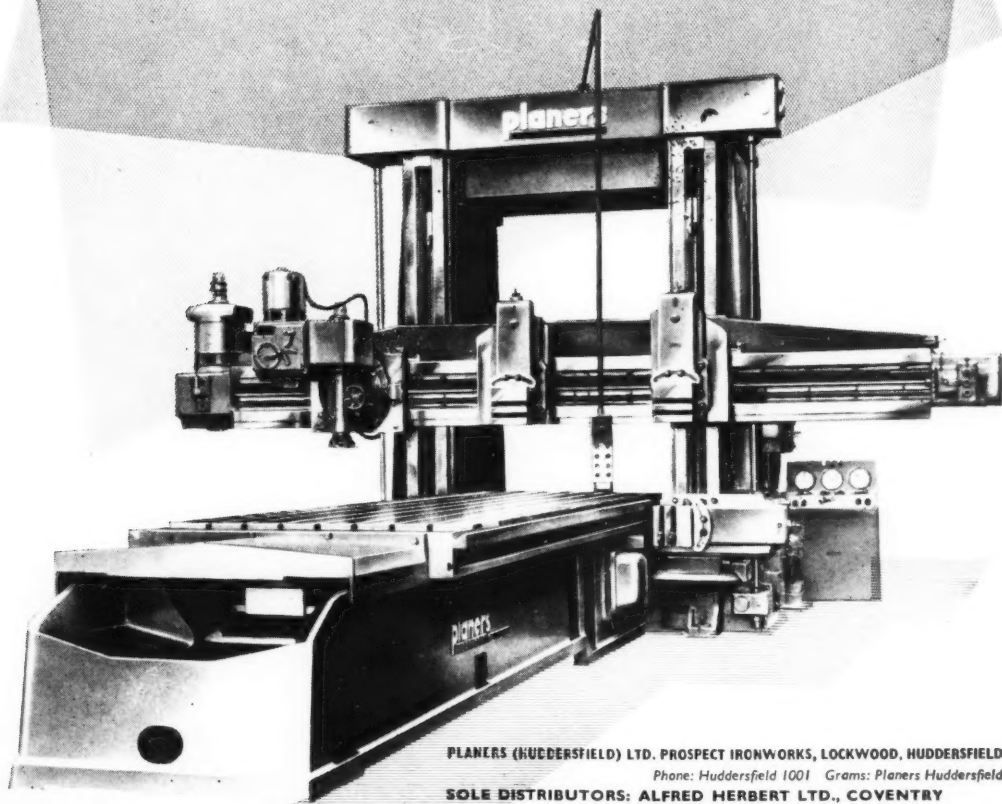
*The Latest  
powerful*

**planers**  
HUDDERSFIELD • LIMITED

**HEAVY DUTY SPIRAL DRIVE PLANER  
WITH 10 H.P. MILLING HEAD**

UNSURPASSED FOR SPEED AND RIGIDITY..

CAPACITY: 16FT. BY 6FT. BY 6FT.



PLANERS (HUDDERSFIELD) LTD. PROSPECT IRONWORKS, LOCKWOOD, HUDDERSFIELD

Phone: Huddersfield 1001 Grams: Planers Huddersfield

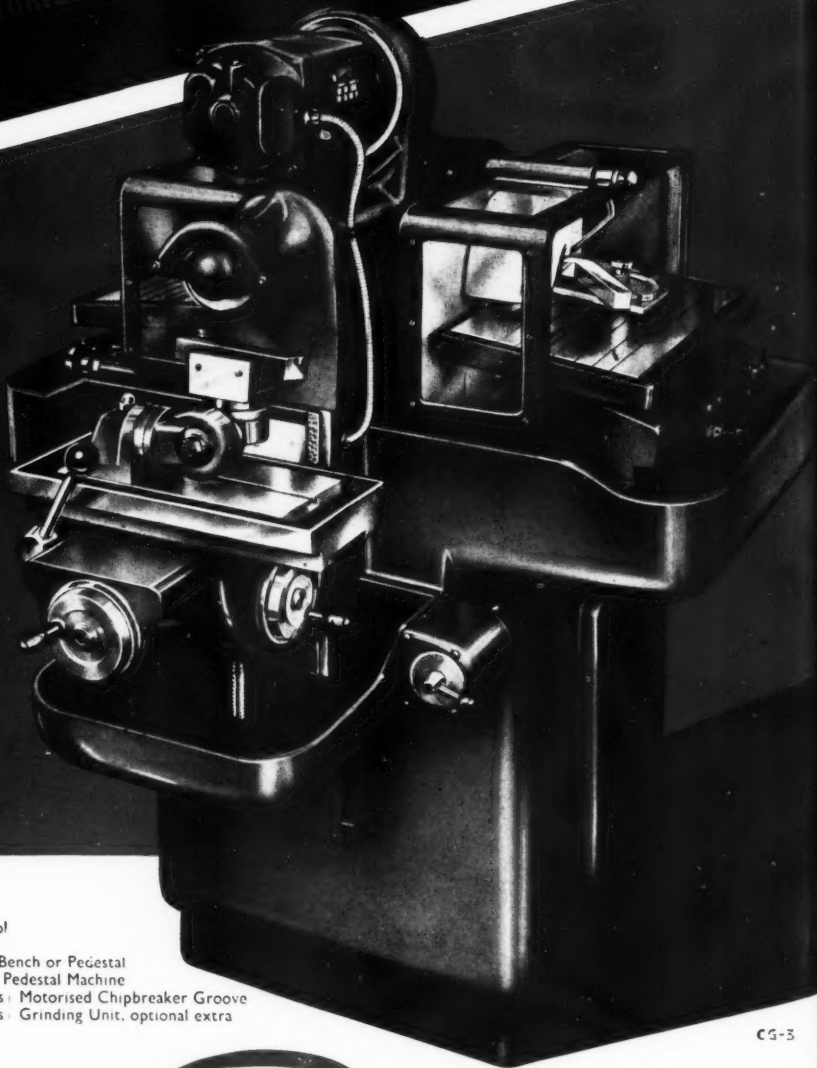
SOLE DISTRIBUTORS: ALFRED HERBERT LTD., COVENTRY

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# ABWOOD 'CONCENTRE' CARBIDE TOOL GRINDER

WITH MOTORISED CHIP-BREAKER GROOVE GRINDING UNIT

- Constant centre height of table to grinding point irrespective of angle
- Adjustable taper roller bearings eliminate end float
- Perspex panelled spray guards provide perfect vision, hinged for easy access to wheel
- Uses diamond wheels to their maximum efficiency
- The Chipbreaker Groove Grinding Unit accommodates turning tools of most shapes and sizes



Our full range of Carbide Tool

Grinding Machines includes:

Model CGO, 6 in. Wheels, Bench or Pedestal

Model CG1A, 8 in. Wheels, Pedestal Machine

Model CG2A, 8 in. Wheels: Motorised Chipbreaker Groove

Model CG3A, 12 in. Wheels: Grinding Unit, optional extra

CG-3

**ABWOOD MACHINE TOOLS LTD. PRINCES ROAD, DARTFORD, KENT**

Telephone : DARTFORD 25271 (5 lines)



Telegrams : ABWOOD, DARTFORD

April 12, 1961

MACHINERY

# FIGURES TELL THEIR OWN TALE

## The intelligent use of **DYSON'S**

LABORATORY CONTROLLED  
**PRESSURE DIE CASTINGS**

can cut your production  
costs

OUR TECHNICIANS WILL GLADLY TELL YOU HOW THE  
LATEST DEVELOPMENTS CAN BE APPLIED TO YOUR  
OWN PRODUCTS. GET IN TOUCH WITH US

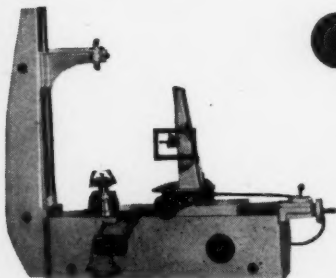


**DYSON & CO. ENFIELD (1919) LTD.**  
SOUTHBURY WORKS, PONDERS END, MIDDLESEX

# Goulder

## GEAR MEASURING EQUIPMENT

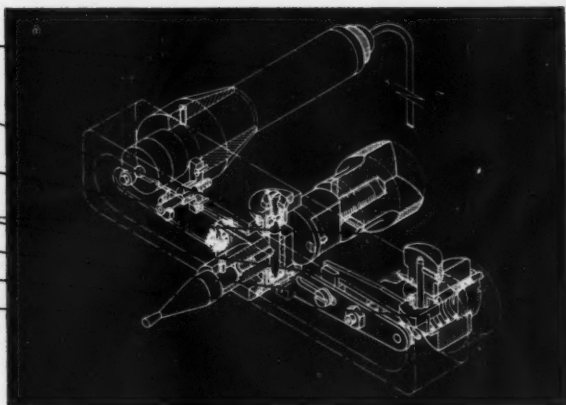
*This series of advertisements is intended to show how attention to detail design backed by careful and precise manufacture has made Goulder gear measuring equipment first choice of buyers who appreciate these qualities.*



### ● INVOLUTE TESTER INDICATING HEAD

used on Goulder Nos. 1, 2 and 3 Involute Testers to measure deviation of profile from true involute.

ELECTRONIC RECORDING USING AXIAL GAUGE HEAD WHICH CAN BE USED ON OTHER INSTRUMENTS WHEN REQUIRED  
PIVOT BEARINGS FOR SENSITIVITY AND ACCURACY  
PROTECTION AND EASE OF OPERATION THROUGH TRAVEL LIMITING DEVICE  
BUILT IN BIASSING THROUGH LEAF SPRING  
SIMPLE MEASURING PRESSURE ADJUSTMENT  
ADJUSTABLE BALANCE SPRING  
INTERCHANGEABLE STYLUS  
UNIT CONSTRUCTION FOR EASE OF MAINTENANCE  
ROBUST AND DUSTPROOF ASSEMBLY



**Goulder** THE NAME FOR ALL GEAR TESTING

**J. Goulder & Sons Ltd.,**

KIRKHEATON, HUDDERSFIELD.

Tel: Huddersfield 5292-3

*When answering advertisements kindly mention MACHINERY.*



April

# Beard and Fitch Ltd

*have been makers of the  
finest quality*



*in Clerkenwell, London since 1851*

*In order to meet the increasing  
demand a new factory has now been  
prepared in Harlow, where full  
production is in progress*

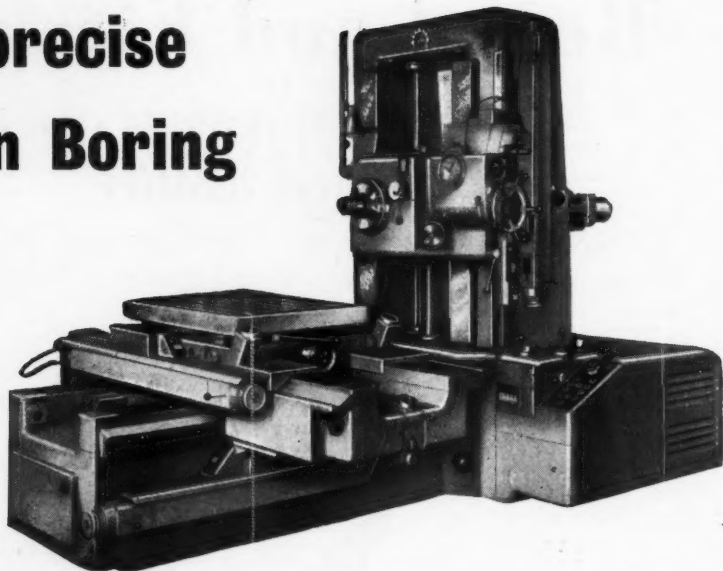
BRITTON STREET  
LONDON, E.C.1  
CLE 6967

EDINBURGH WAY  
HARLOW  
Harlow 25358

# **NOW...**

## **— really precise**

### **Repetition Boring**

**SWISS****DIXI****HORIZONTAL OPTICAL JIG BORER MODEL 75 OG**

With bridged double columns the DIXI '75' is immensely rigid. Optical settings direct reading to .00005" are required for the first workpiece only and with semi-automatic positioning can be repeated quickly and accurately on subsequent components. Quick change pre-set tools permit rapid operation. Built-in rotary table has projected settings to 1 sec. and swivels through 360° permitting work to be machined from each side, or at compound angles, without disturbing its setting. Additional 17½" optical circular table with dividing accuracy of 1 sec. can be mounted horizontally or vertically.

*Boring spindle dia. 3". Table size 39½" x 32"*  
*Traverses: Longitudinal 23½", transverse 29½", vertical 25½".*

Send for the fully illustrated brochure M/186.

SOLE U.K. DISTRIBUTORS

**DOWDING & DOLL LTD****346 KENSINGTON HIGH STREET, LONDON, W.14**

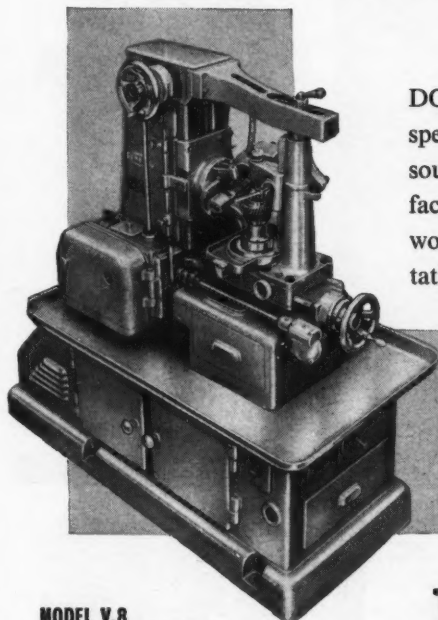
Tel: WESTERN 8077 (8 lines) Telex: 23182 Grams: ACCURATOOL LONDON TELEX

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When answering advertisements kindly mention **MACHINERY**.

# HOBBIING

—it pays to investigate

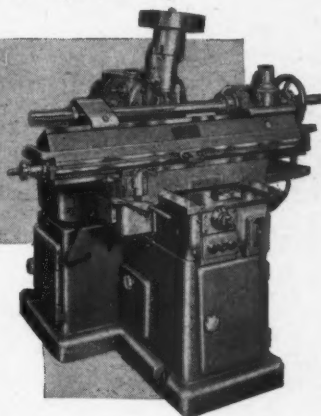
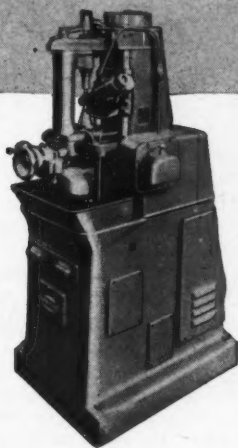


**MODEL V.8**  
**UNIVERSAL HOBBIING MACHINE**

Accurate, versatile, economical. With built-in differential. For spurs, helicals, wormwheels, and worms. Tangential feed and cam operated plunge feed are optional extras. Maximum dia. 8", 7" Face. 12 D.P.

**MODEL V.4**  
**UNIVERSAL HOBBIING MACHINE**

Accurate, rigid, and versatile. With built-in differential. For the smaller spurs, helicals, worm wheels, and worms used in light engineering and instrument work. Tangential feed is also available. Up to 4" Diameter, 4" face, 20 D.P.



**MODEL H.7**  
**HORIZONTAL HOBBIING MACHINE**

Powerful and rigid. With built-in differential. For long splines and gears integral with long shafts, and parallel and taper serrations. Alternative heavy duty or high helix angle hob heads. Maximum dia. 7". Hobbing length 18". 8 D.P.

*Ask us to send our new illustrated Hobbing brochure M/128*



**DOWDING & DOLL LTD**

346 KENSINGTON HIGH STREET, LONDON, W.14

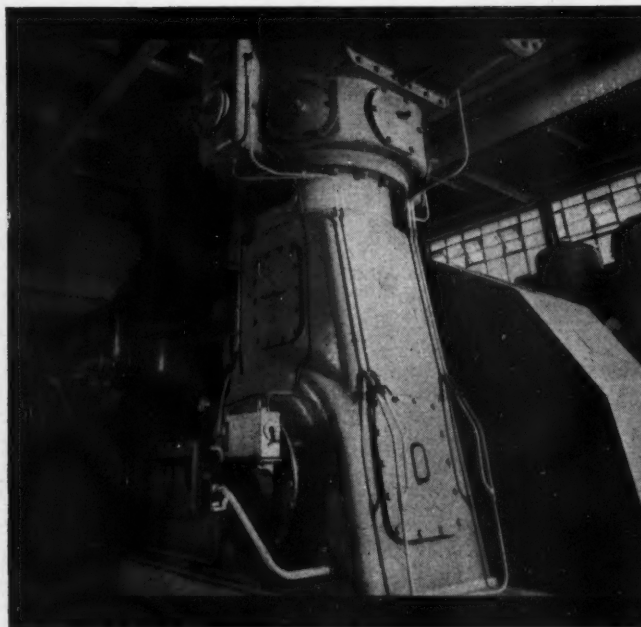
Tel: WESTERN 8077 (8 lines) Telex: 23182 Grams: ACCURATOOL LONDON TELEX

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*When answering advertisements kindly mention MACHINERY.*

B2

## THE VITAL STATISTICS OF AIR POWER



Atlas Copco make stationary compressors for every purpose. Whatever the needs of industry, the extensive Atlas Copco range—reciprocating machines from 2.5 to 3,200 c.f.m. and Twin Air rotaries up to 20,000 c.f.m., ensure specialised equipment to meet specialised demand.

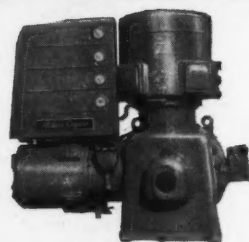
Whether industry is concerned with electrical power economies, the high cost of water for water-cooled units or that ever present problem, space shortage, Atlas Copco can help you in the provision of a suitable compressor to overcome your particular problem.

Atlas Copco are pleased to offer specialised advice and consultation on your installation, and leaflets describing the range of Atlas Copco stationary compressors are readily available on request. Write, giving some indication of the type of machine you are interested in, to your local Atlas Copco branch or to the Head Office.

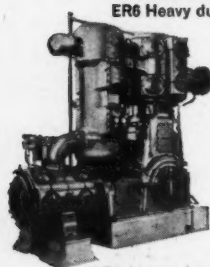
**Atlas Copco** compressed air engineers

### ATLAS COPCO (GREAT BRITAIN) LIMITED

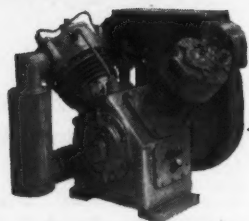
Maylands Avenue, Hemel Hempstead, Herts. Telephone: Boxmoor 6040  
Sales and service depots at: LONDON: BRISTOL: CARDIFF: LICHFIELD: LEEDS:  
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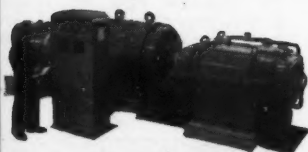
ER6 Heavy duty type



AR9 L type, heavy duty



NT9 Small, continuous duty type



TWIN AIR Rotary Screw

Engineering, Marine Welding Exhibition—Atlas Copco Stand No. 4, Row R, Ground Floor, National Hall, Olympia.

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This range of machines are economic units whether for mass production, small batch quantities or single parts, where high accuracy, efficiency and speed are a necessity. They can handle small pinions with  $\frac{1}{2}$ " bore to ships' propellers with 5' bores weighing 30 tons.

Model KZ.50 for keyways from  $\frac{1}{4}$ " to  $1\frac{1}{2}$ " in width and up to  $17\frac{1}{2}$ " length.



Even 25% utilisation makes the FROMAG Machines an economic proposition. A combined tilting and floating table can be supplied for cutting keyways in cylindrical bores and for keywaying taper bores. The larger machines can also be used as vertical broaching machines, 6-ton capacity.

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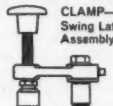







April

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Did you know that many of the jigs and tools prepared at great expense by your most skilled men can be assembled from high quality standard components supplied by Woodside? The fast-growing range already includes 30 basic tooling accessories in 300 individual forms, each available in numerous sizes. In today's competitive conditions, speed of re-tooling is often a decisive factor. Most WDS Tooling Aids are immediately obtainable from stock. The remainder can be supplied within days.

	
NUT—Acorn	WASHER—Plain
	
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CLAMP—Swing Latch, Assembly	TAPERLOCK JIG—Major, Tray
	
KNOB—Star	NUT—Coupling
	
SCREW—Torque (Jack Type)	V. SECTION
	
LOCKNUT—Torque Screw	LATCH—Swing

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THESE FIRMS FIND IT PAYS TO USE WDS TOOLING AIDS. *Aveling-Barford Limited (Grantham), Burco Limited (Burnley), The de Havilland Aircraft Company Limited, Dimplex Limited, The English Electric Company Limited, Fairey Aviation Limited, Fairey Engineering Limited, Ferodo Limited, Ferranti Ltd. (Hollinwood), Handley Page (Reading) Limited, Humber Limited, Jaguar Cars Limited, A. A. Jones and Shipman Limited, Morphy-Richards (Cray) Limited, The National Cash Register Company (Manufacturing) Limited, Peto Scott Electrical Instruments Limited, The Pyrene Company Limited, Simpler Electric Company Limited, Westland Aircraft Limited.*

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## $\text{CH}_3\text{COCH}_2\text{C}(\text{OH})(\text{CH}_3)_2$

These are familiar symbols; *far* from meaningless to the Plant Engineer.

They represent one of the hundreds of chemicals which are enemies in minor or major degree of the materials with which they are in contact—some are pernicious enemies.

But for the manufacturers of the plant and equipment in which they are contained or processed, life is not so difficult as it once was.

Materials are now more or less freely available which are virtually impervious to attack by corrosives or solvents. Difficulties still are encountered, especially in terms of the character of the materials which do not always lend themselves to the conventional techniques by which the older metals are fabricated. Their initial cost, too, is high.

The skill and ingenuity of the manufacturer leads him to employ divers means to overcome these difficulties. For example, chemically inert materials frequently are used as linings on the surfaces of vessels which are fabricated from materials which, if unprotected, would have only a short life.

However, on plant and equipment such as pumps, agitators, mixers, valves, etc., there remains the problem of sealing against leakage where a rotating shaft passes through the body or casing. Here, a pump, or a vessel, is most vulnerable.

Means must be employed not only to seal against leakage of liquid or gas which may be highly corrosive or solvent, but the method of sealing must be capable of resisting any tendency for shaft movement to impair its efficiency.

Today, mechanical shaft seals are widely used for this purpose.

The Plant Engineer and the Manufacturer of the plant and equipment must decide of whose manufacture the mechanical seal must be.

This must boil down to a question of

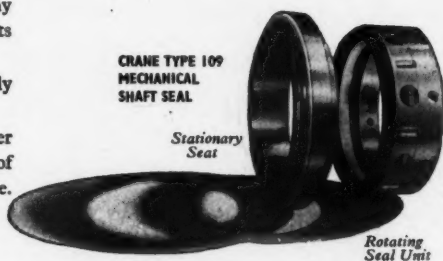
confidence in their supplier; that is to say, confidence born of previous experience of a supplier's recommendations, or if a new supplier, knowledge of that supplier's reputation for supplying mechanical shaft seals, which by their performance in the field have proved they may be used with confidence.

In the chemical and allied industries, the mechanical shaft seals manufactured by CRANE PACKING LTD. have proved in service over many thousands of hours of operation that the Company's understanding and experience of applications involving the handling of corrosives and solvents is worthy of any users' confidence.

One mechanical shaft seal which has earned for itself an outstanding reputation in the chemical and allied industries, in a relatively short space of time, is the CRANE Type 109. This was the *first* mechanical shaft seal ever to be manufactured in this Country capable of sealing against *other than* mildly corrosive or solvent liquids and gases.

Normally the "109" has a pressure ceiling of 150 p.s.i.g., but by using a balanced version of the seal it is possible to seal against pressures as high as 750 p.s.i.g. Its temperature range is up to +450°F. (232°C.).

The CRANE Type "109" is more fully described in Information Bulletin No. 7 now in its fourth printing.



ISSUED BY THE MECHANICAL SEALS DIVISION OF



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# SPRAY BOOTH MAINTENANCE

## CUT BY 90%

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### NOPUMP SPRAY BOOTH

- Longer time between clean-outs
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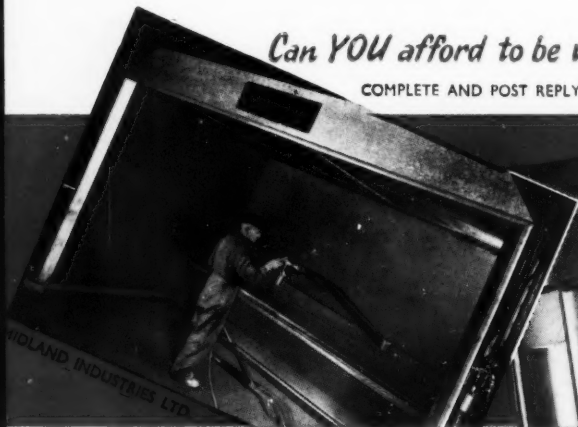
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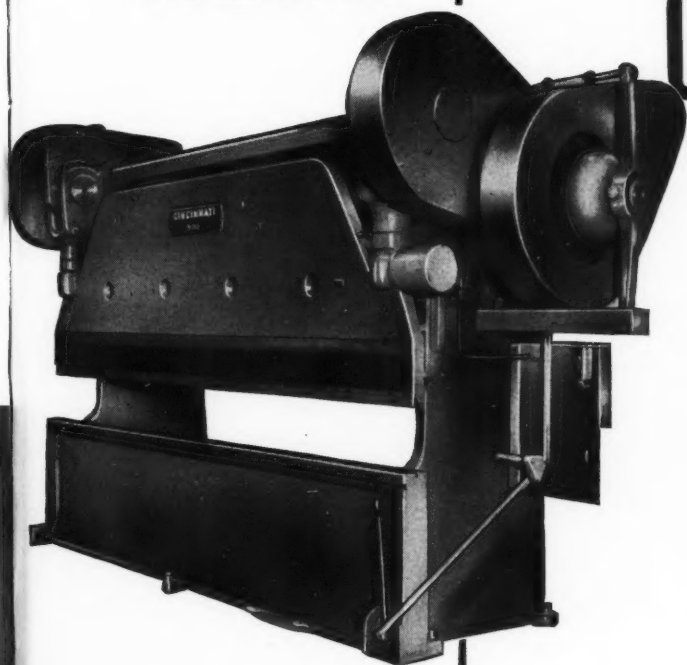
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Machine Tool  
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**BRITISH BUILT  
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*all steel*

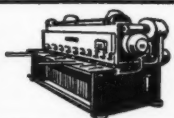
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The all-steel  
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... FOREMOST IN THE FIELD

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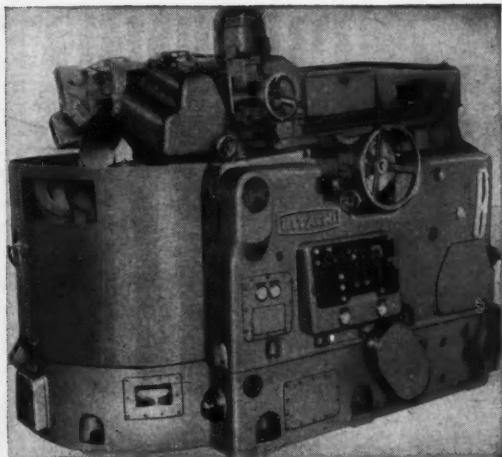
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**(MACHINE TOOLS) LIMITED**

GARANTOOLS HOUSE PORTLAND ROAD HOVE SUSSEX  
Telephone: HOVE 47251 Telegrams: Garantools, Port. Ind.

LONDON BIRMINGHAM GLASGOW MANCHESTER BRISTOL

## Efficiency *plus* **HITACHI** Bevel Gear Grinder



HITACHI Bevel Gear Grinder Type 600 BG-1

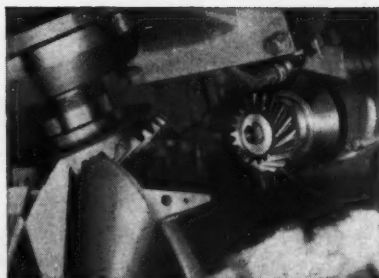
### Characteristics:

The HITACHI bevel gear grinder, Type 600 BG-1, has been designed on an entirely new principle of generating method, and is credited with the following features:—

1. The machine can be operated with utmost ease.
2. Crowning is possible even in the direction of gear teeth.
3. The same grinding wheel can be used irrespective of dimensions, helix angles, pressure angles of the bevel gears to be processed.
4. Meshing tests can be conducted without removing the processed gear.

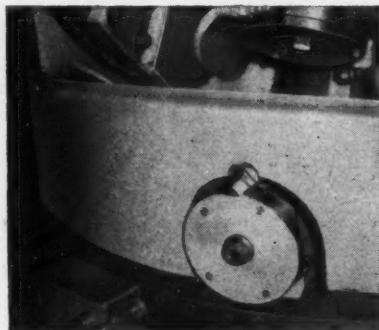
### Specifications:

Max. pitch dia. ....	610 mm.
Min. pitch dia. ....	50 mm.
Largest cone distance ....	305 mm.
Pressure angle ....	14½°—20°
Max. helix angle ....	35°
Module ....	2.5M—8M
Dia. of grinding wheel ....	400 mm.
Main Motor ....	5 h.p.
Size of Machine 2,765 mm. x 2,000 mm. x 1,850 mm.	
Net Weight ....	approx. 11,00 kg.



WORK HEAD

The photo shows that a set of gear and pinion is fitted on each work head.



DIAL FOR AUTOMATIC SETTING

The table constructed in the two-stage type, and is provided with a screw for parallel slide and a dial.

### Patents on this grinder:—

Patents have been applied for in the United States, Britain, Germany, Switzerland and Italy, in addition to those already taken out in Japan.

### Other HITACHI products include:—

Gear hobbing machines  
Knee-type milling machines  
Surface grinders  
Roll lathes and grinders  
Railway car wheel lathes  
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Tokyo Japan

Cable Address: "HITACHI" TOKYO

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**SPEED FINISHING**

**GIVES THE SAME UNIFORM FINISH  
EVERY TIME . . . TEN TIMES FASTER**

Using Almco Supersheen barrel-finishing equipment and materials, unskilled operators can turn out precision **DEBURRING, DESCALING, BURNISHING, POLISHING**, etc., with practically no rejects, with savings of up to 87%, at ten times the speed of hand-finishing.

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**ALMCO**

***Supersheen***

**BURY MEAD WORKS : HITCHIN : HERTS**

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**A Division of the King Seeley Corporation, Ann Arbor, Michigan, U.S.A.**



Model DB400/3/36  
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Please send for details.

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## 30in. High Production Slotter



with electric feed and traverse unit,  
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from pendant push  
button switch.



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**PLANERS**  
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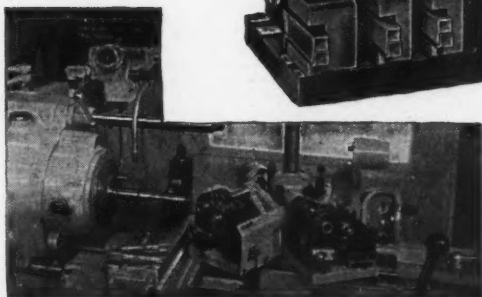
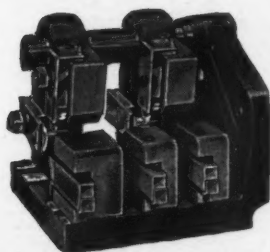
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*For stepped diameters at High Speeds*



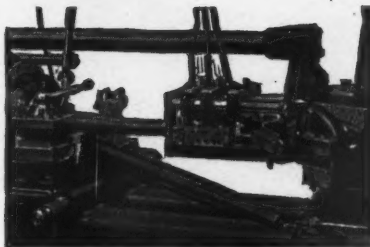
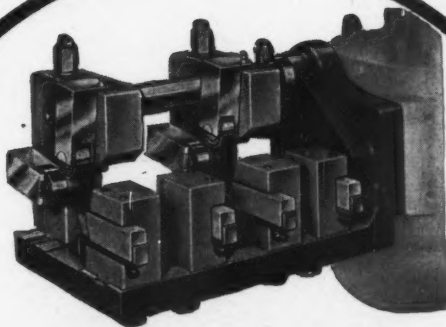
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Constructed for turning one, two, three or more diameters with tungsten-carbide tools, these holders present the tools to the work in quickly set robust slides having independent adjustment. The roller holders are interchangeable and can be locked in any position along the body.

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W672



Glenfield & Kennedy Ltd. are highly satisfied with their "Town" 8ft. C.E.2. Heavy Radial Drilling Machine, which has centralised control and drills  $3\frac{1}{2}$ " from solid in mild steel and cast iron.

Other sizes available.

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MAKERS OF HIGH CLASS DRILLING MACHINES FOR 58 YEARS

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*It means you can pack in sets, ready for assembly.*

*It gives you handy packs that sell your product.*

And at low cost? Yes, because you save labour—packing is just one simple, fully mechanised operation.



## Put Foil's Top Team to work for you

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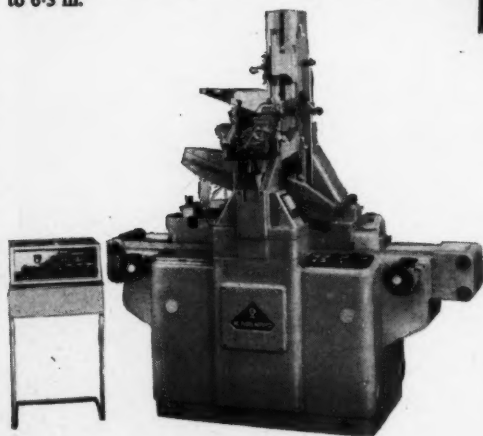


**Klingelberg Involute & Helix Tester  
Model PFS 600**

For checking involute form, concentricity, surface finish, helix and base circle errors etc., of spur or helical gears. Also checks lead angles of worm-type components. Capacity: 23½ in. component diameter, 1½–34 D.P. Helix angles up to 90°, face widths up to 6.3 in.



## equipment



**Klingelberg Hob Tester  
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For checking lead, pitch, flank contour, spiral angle etc. Test results are automatically charted by an electronic recorder unit with adjustable magnification up to 1000-1. Capacity: up to 10 in. diameter, 1½–10 D.P.

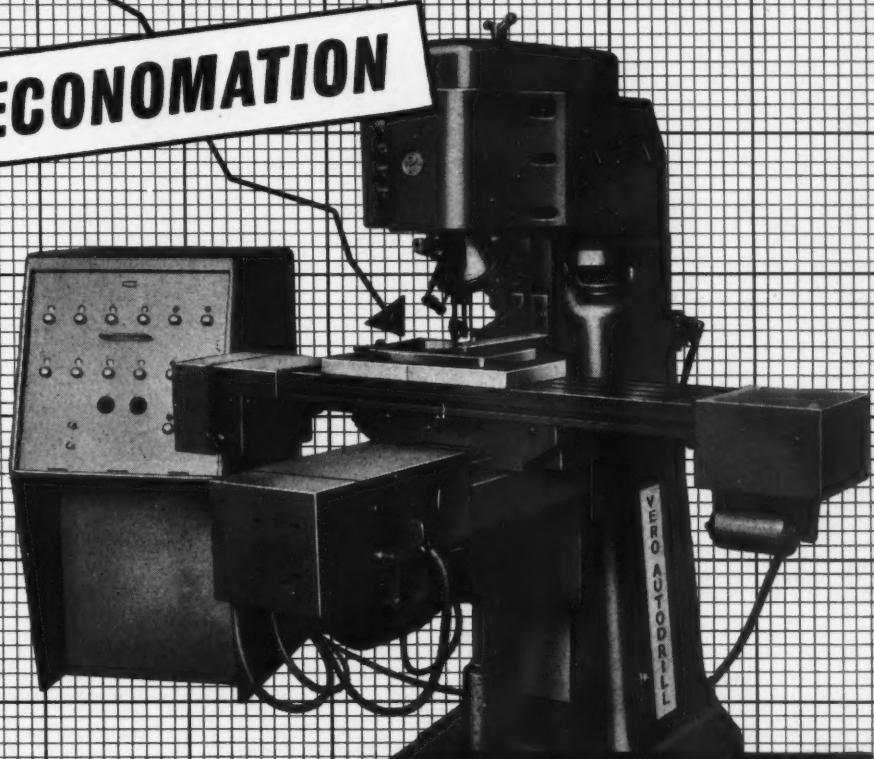
The Klingelberg range of testing equipment covers all requirements in the field of gear and hob inspection. Please write for an informative general catalogue of Klingelberg products or request details of models for your specific products.

**SYKES MACHINE TOOL COMPANY LIMITED**

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# *Cut Costs with* **VERO AUTO-DRILL**

**ECONOMATION**



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MACHINE IS FULLY AUTOMATIC  
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HEAD AND TOOL SELECTION

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MACHINE TOOL CORPORATION LIMITED

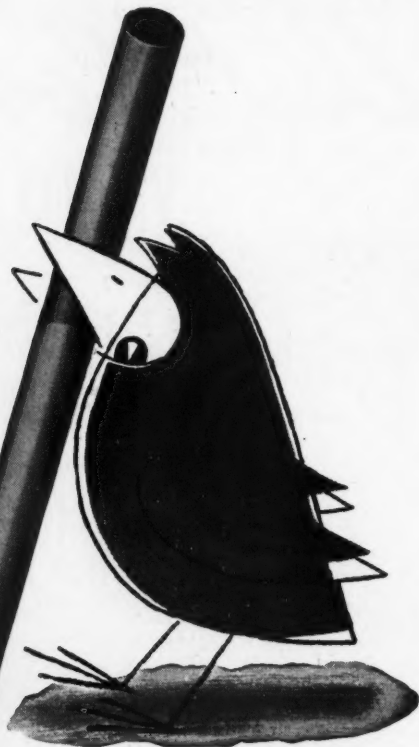
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**Nettlefold & Moser**



Nettlefold & Moser give a speedy delivery service from a wide range and extensive stocks.

These include:

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rounds, squares, hexagons, angles, flats.

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to Spec. EN 1 A: rounds, hexagons.

**'Mills' Bright Steel**

to EN Specifications.

*Nettlefold and Moser Ltd. are main stockholding agents for Exors. of James Mills Ltd.*

**NETTLEFOLD & MOSER LIMITED**

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**HULL** — 201 SCULCOATES LANE, TEL: CENTRAL 41341 (3 lines)

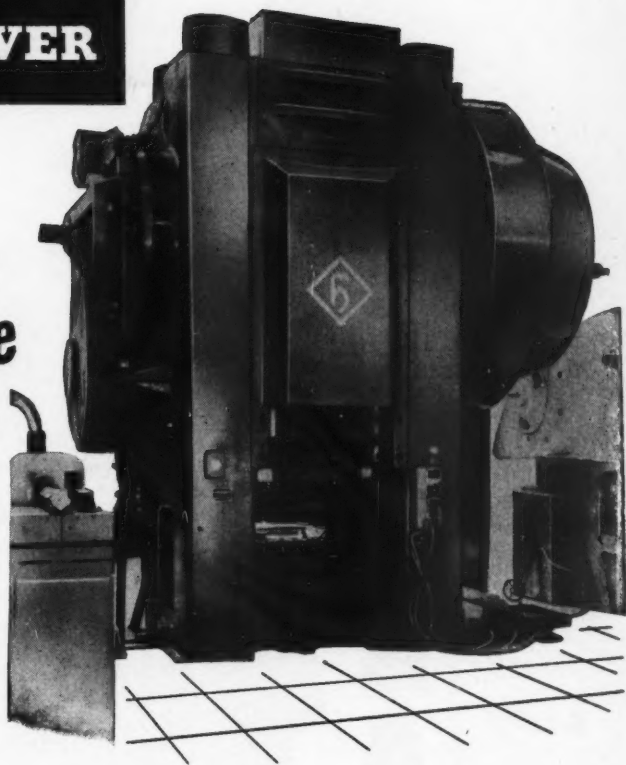
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*Eccentric Type  
Forging  
Presses*



One of three Hasenclever forging presses, producing precision forged heavy bevel gears in a modern car factory. 100 to 6,000 tons.

By courtesy of



MOTOR CO., COLOGNE, GERMANY



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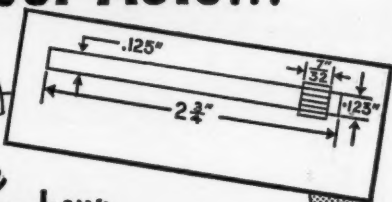
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**AUTOMATIC  
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THERE'S A  
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FOR MOST  
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MACHINES



\* YOUR AUTO IS NOT FULLY AUTOMATIC  
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Patents Nos. 728898 and 743461, 827417

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- ★ Hardened and ground gears

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Spindle speeds			
(9)	45-1,500 or 54-1,800 r.p.m.		

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LOW TUNGSTEN

### HACKSAW BLADES

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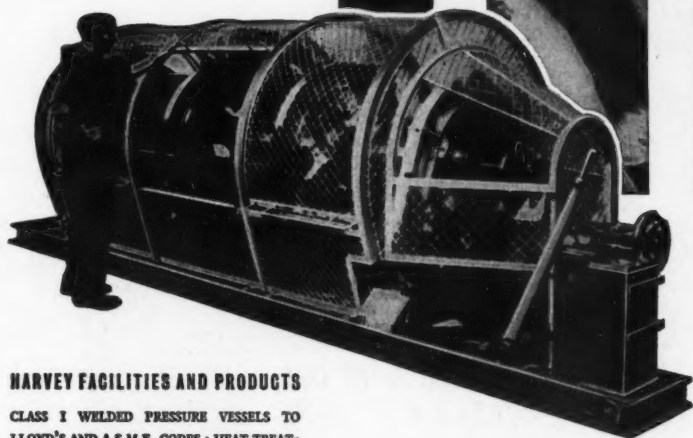
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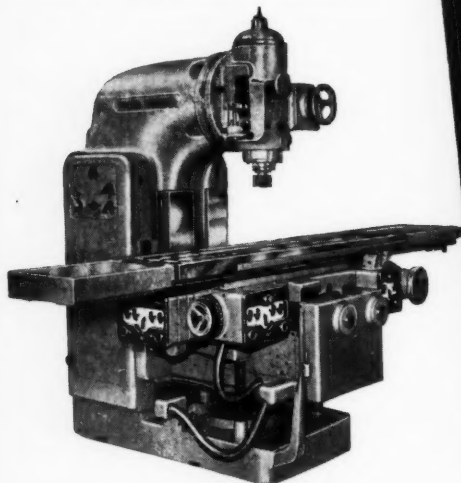
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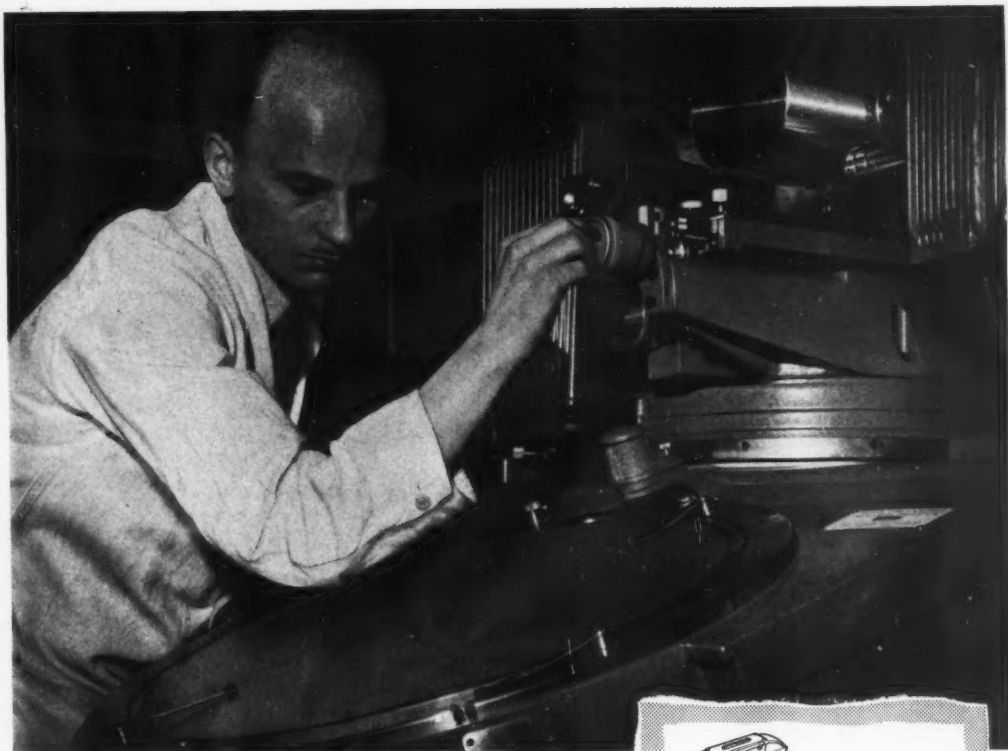
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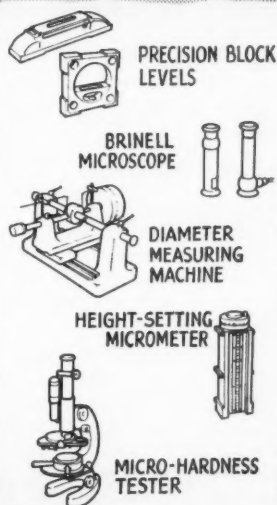
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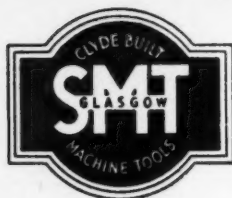
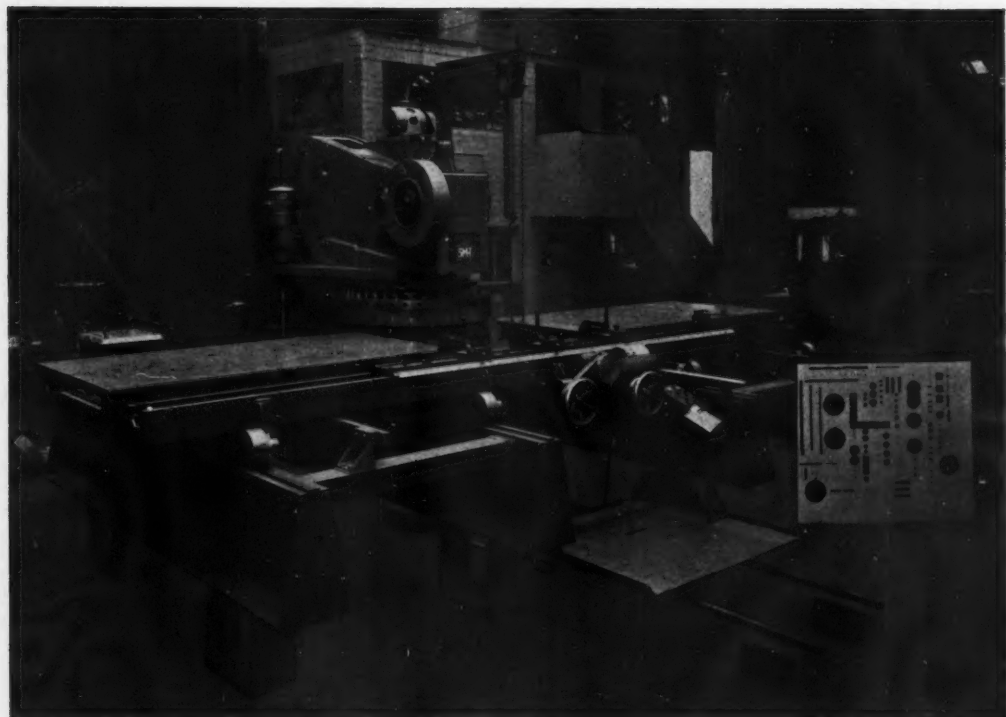
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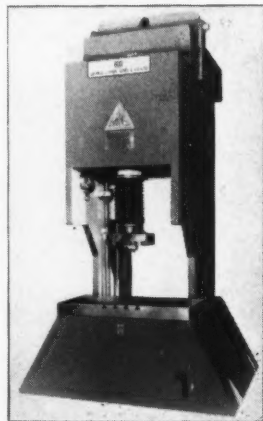
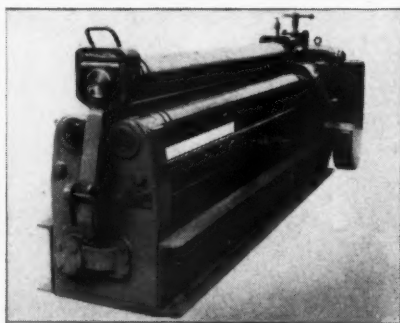
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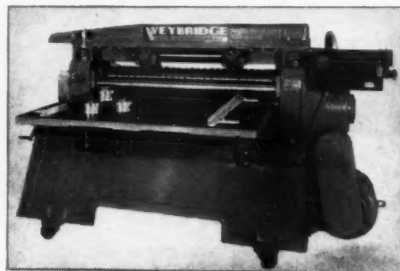
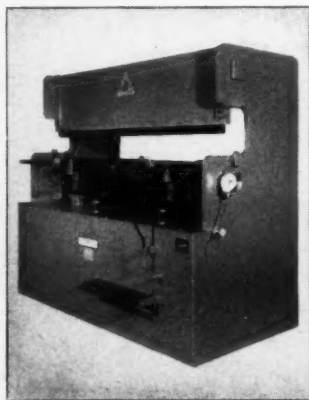
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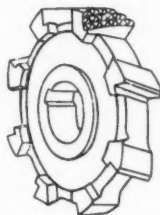
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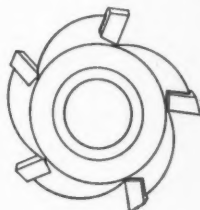


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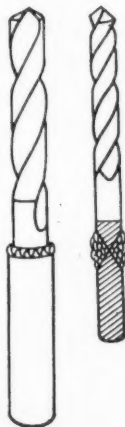


(left) "ToolTectic" alloys used to deposit HSS on mild steel blank forming cutting tools and (below) thin-flowing high-silver alloys in paste and rod form used to mount carbide tips.

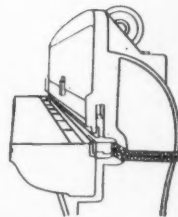


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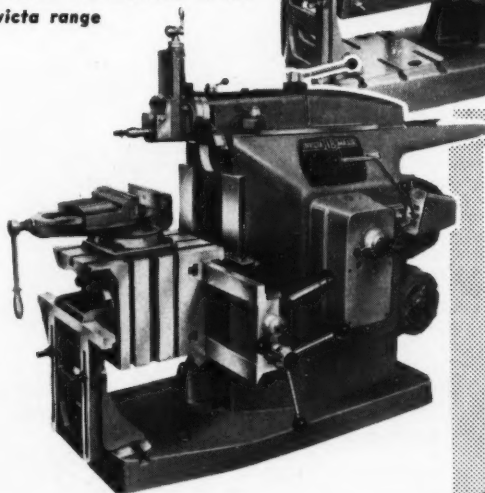
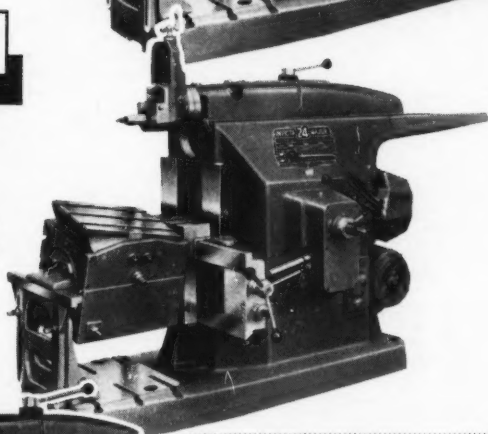
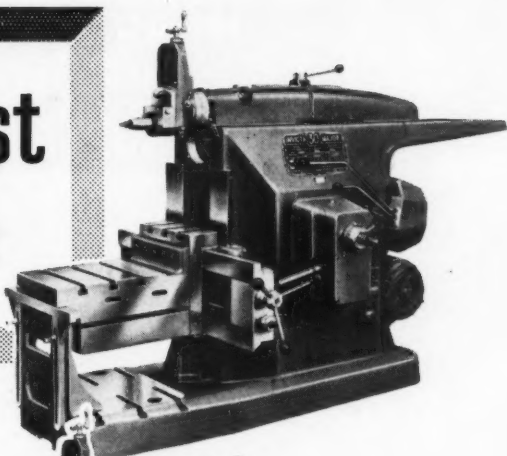
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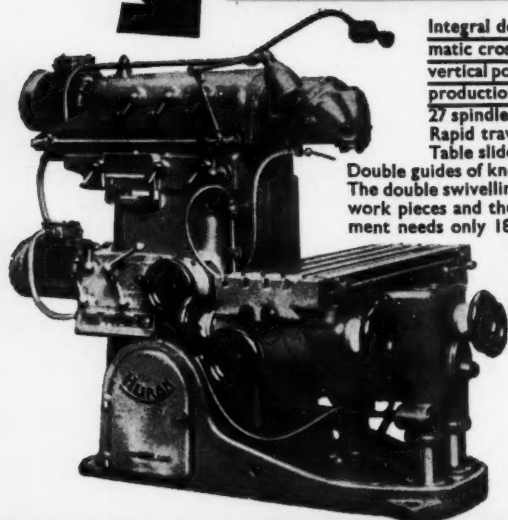
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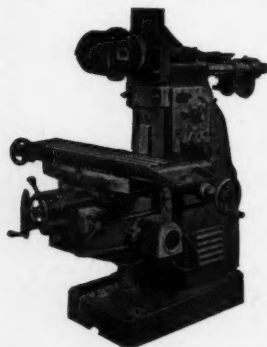
Type	Table	Automatic Feeds		
		Long	Cross	Vert.
KU4	56½ in. x 15½ in.	43½ in.	27½ in.	19½ in.
KU5	64½ in. x 15½ in.	51 in.	27½ in.	19½ in.
KU6	78 in. x 16 in.	59 in.	27½ in.	19½ in.
KU55	64½ in. x 26 in.	51 in.	39 in.	18½ in.
L83	157 in. x 59 in.	118 in.	39 in.	59 in.

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ON No. 59 AND 21 ON No. 61

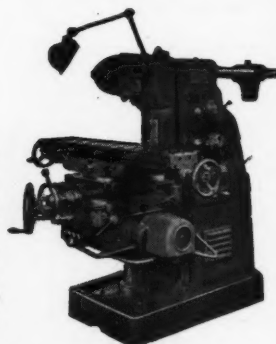
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MODEL 54. Automatic cross feed of universal head 20 in.; 18 universal head spindle speeds 12-1500 r.p.m.; 36 horizontal spindle speeds 6-1500 r.p.m.; 18 automatic feeds ⅛-23½ in.

Type	Table	Automatic Feeds		
		Long	Cross	Vert.
53	43½ in. x 9½ in.	27½ in.	9½ in.	15½ in.
61	47½ in. x 10½ in.	30½ in.	9½ in.	15½ in.
59	51½ in. x 11½ in.	34½ in.	11½ in.	21½ in.
54	67 in. x 14½ in.	43½ in.	14½ in.	20½ in.



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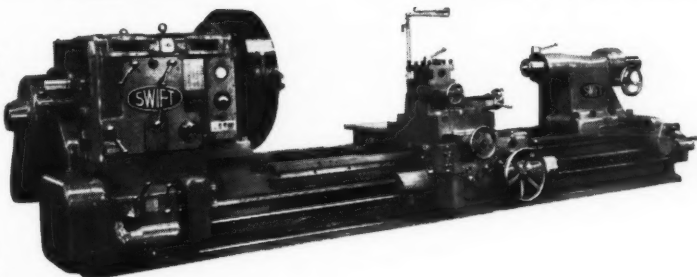




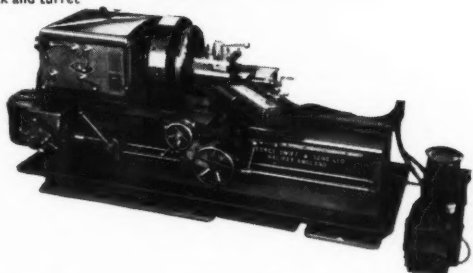
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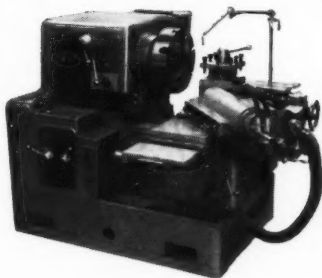
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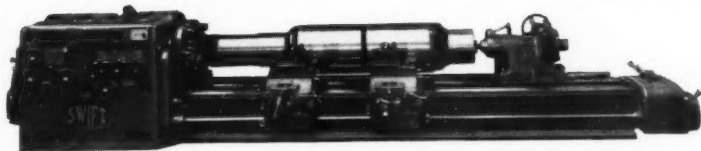
125V6 Lathe, 28in. swing, with 2ft. 6in. between chuck and turret.



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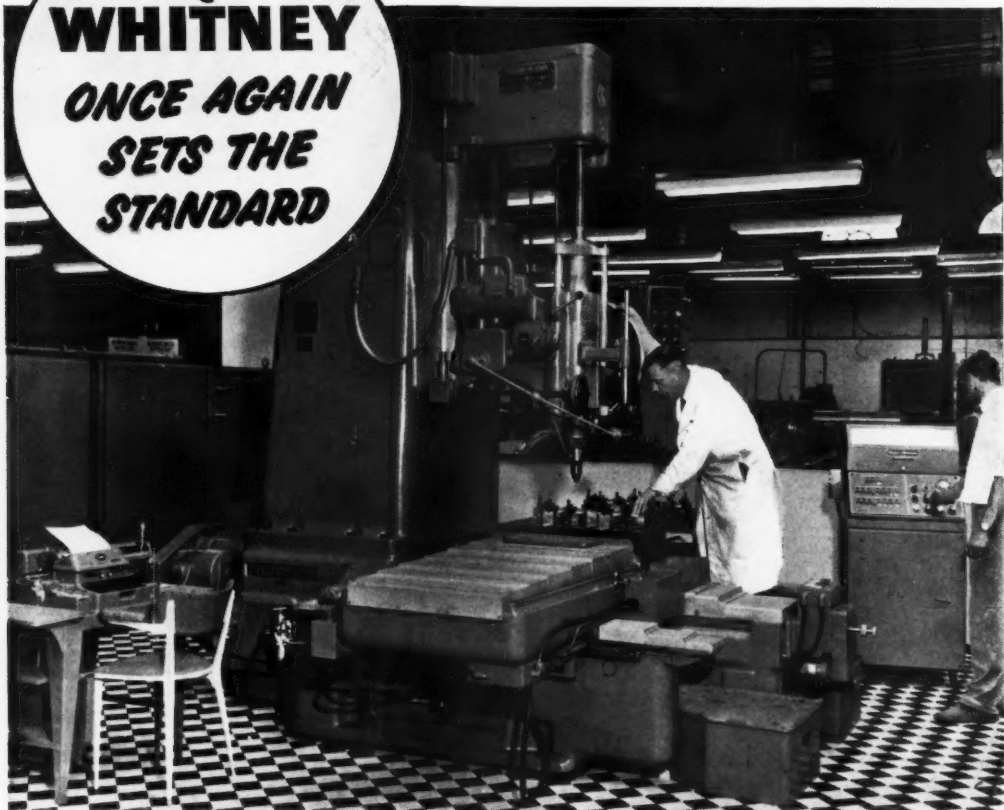
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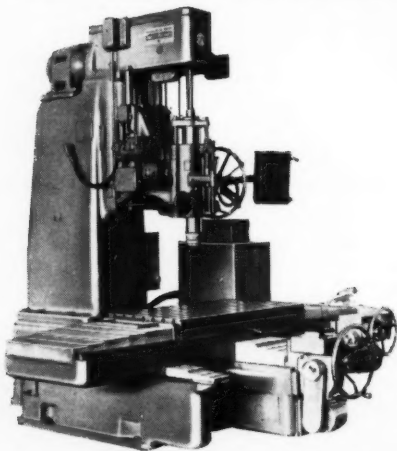
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**BUCK & HICKMAN LTD.**

Otterspool Way, Watford By-Pass, Herts.

Head Office. P.O. Box 74, Whitechapel Road, London, E.1.

Branches. Alperton, Birmingham, Bristol, Glasgow, Leeds, Manchester.



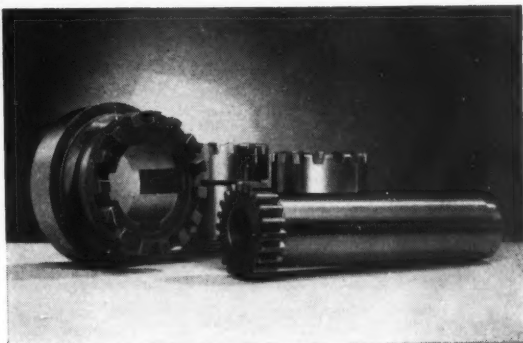
## The Saving is inside

**SANDVIK** Mechanical Tubing is the economical material for the production of sleeves, cylinders and all ring type components. A "Ready-made" hole avoids the wasteful removal of material you cannot use.

Use **SANDVIK** Mechanical Tubing, the modern method of production and material economy.

**SANDVIK** Mechanical Tubing, available from stock in Birmingham:  
72 STANDARD SIZES in .35% Carbon Steel, B S I En 6.

**Why pay  
for steel  
you don't  
use?**



Write or phone for  
detailed information  
and technical  
brochure E-370.

## **SANDVIK** MECHANICAL TUBING

Saves material, time, labour, tools.

**SANDVIK SWEDISH STEELS LTD**



Manor Lane  
Halesowen Birmingham  
Telephone: Halesowen 2121  
(7 lines)  
Telex: 33164

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## LET'S GET THIS STRAIGHT...

You don't want a lot of mumbo-jumbo. When you're out to buy industrial hose you want the facts in plain English. So at Dunlop we tell you straight that this hose is the strongest, this the most flexible, this the most oil resistant, and so on. And you can take our word for it because we make the finest range of hose in the world. Is there a problem at the moment? Then tell us what the hose has to carry, at what pressure, in what quantity, over what distance, and it's as good as delivered. Drop us a line—or put through a trunk call.

**DUNLOP HOSE**

DUNLOP MAKE HOSE BETTER TO LAST LONGER

DUNLOP RUBBER CO. LTD., (HOSE DIVISION), EARLSWAY, TEAM VALLEY, GATESHEAD 11.

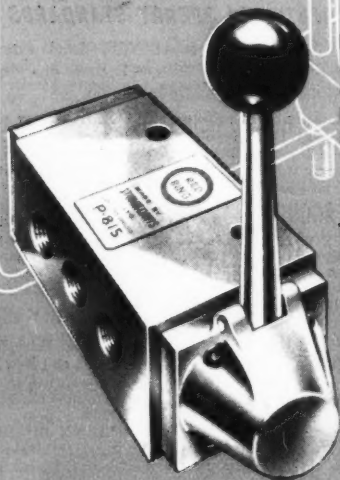
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## controlling a fluid power

BY HAND  
BY FOOT  
BY PUSH BUTTON  
BY CAM  
BY SOLENOID



**RED RING** **AIR EQUIPMENT**

One of the most popular range of valves is this P.800 series available as lever, foot, toe, air pressure or solenoid operated. The basic valve is engineered to give the maximum number of trouble free operations, unaffected by dirt because it is self cleaning, full air flow through valve giving faster response to cylinders, and easy fixing to any machine, make this range the most versatile available.  $\frac{1}{2}$ " and  $\frac{1}{4}$ " BSP sizes.

Manufactured by the Makers of Fine Machine Tools

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For this off, join it to your  
intermediate you get to  
**STUART DAVIS**  
WILLENHALL COVENTRY  
\*RED RING\*  
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## HOFFMANN & SPERRY

### HOFFMANN... THE PEOPLE INTERESTED IN SPERRY STANDARDS

Navigators of ships and aircraft, each vitally concerned to achieve the safe and timely arrival of their craft, put their faith in Sperry compasses and instrumentation.

HOFFMANN BEARINGS, fitted extensively to Sperry instruments, help them to function consistently and accurately to Sperry standards.

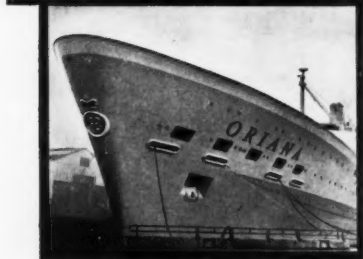
Like many other well-known civil and military aircraft, the Handley Page Dart Herald Branch Liners ordered initially by B.E.A. and Jersey Airlines, rely extensively on Sperry equipment for automatic flight control and instrumentation, the latter including Gyro horizons and Gyro-syn® compasses employing Hoffmann **GLOBAL ACCURACY** Bearings. The trouble-free performance of these instruments was demonstrated in the most practical manner by the prototype and first production aircraft respectively in four recent demonstration tours to India, South America, Australasia and West Africa. Sperry Gyro-syn Compasses have, for many years, depended on Hoffmann Bearings for long life, accuracy and reliability.

The record of Port Line's M.V. Port Fairy, 8,406 tons, includes 65 round voyages between U.K. and New Zealand in 32 years, guided by a Sperry Mark VIII Gyro Compass. Since 1943 the 51 lb. weight of the compass rotor has spun steadily **35,000,000,000 REVS** at 6,000 r.p.m. upon its **HOFFMANN BEARINGS** and to date has completed more than 35,000,000,000 revolutions. It is still spinning, trouble free, and accurate upon those same **HOFFMANN BEARINGS**.

T.S.S. Oriana, P & O - Orient Lines 42,500 tons luxury liner, sailed on her maiden voyage to Australia, New Zealand, and the Pacific coast of U.S.A., following a course set by a Sperry Mark XIV Gyro Compass. This Compass provides the heading reference for the gyro-hydraulic **MAIDEN VOYAGE** automatic steering-control, the direction-finding system, radar installations, and several compass repeaters. These include an enlarged-scale steering repeater, two bearing repeaters on the Bridge wings, and a repeater in the steering-gear flat. Three out of four of the World's merchant ships are set upon their courses by Sperry Gyro Compasses, the majority of which employ Hoffmann Bearings.



Assembling the Gyro Rotor for a C.L.2 Gyro-syn® Compass. Note the dustproof dispensers containing the bearings.



Illustrations by courtesy of Sperry, Handley Page, Port Line and P & O - Orient Lines.

Manufacturers of **BALL AND ROLLER BEARINGS**



THE HOFFMANN MANUFACTURING CO. LTD., CHELMSFORD, ESSEX. Telephone: Chelmsford 3151. Telex No. 1951



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- \* IMPROVED PITCH SELECTION
  - \* INCREASED PITCH ACCURACY
  - \* REDUCED HANDLING TIMES
- ON

**PRECISION LATHES  
WHEN**

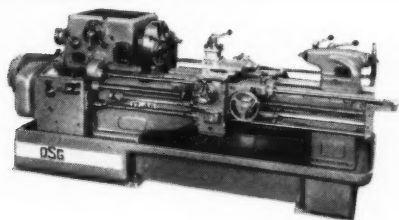
**MULTI-START &  
COARSE PITCH  
THREADING**

Each size of lathe in the D.S.G. range incorporates a totally enclosed screwcutting Gearbox, providing the means for rapidly selecting thread pitches.

The Headstock is fitted with a feed increasing device for coarse pitch threading.

The lathe spindle is fitted with an indexing dial which indicates the precision indexing obtained from a ground divider in the Headstock. This dial is standard equipment on TYPES 13-1 and 17 Toolroom lathes.

WHEN MULTI-START AND COARSE PITCH THREADING, THE COMBINATION OF THESE FEATURES ENSURES THAT ALL THE ABOVE ADVANTAGES ARE OBTAINED.



**DEAN, SMITH & GRACE LTD. KEIGHLEY, ENGLAND**

Telex No. 51-123 • Telegrams: LATHES Keighley  
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Manufacturers of  
13-30" Swing Engine Lathes  
Surfacing and Boring Lathes  
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# The 'Rainbow' Finish Series

## VERALOY

### steelcutting grades

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**VL.12**

for high turning speeds. Due to its toughness can be used in much worse conditions or heavier cuts than is normal for this type of grade. Corresponds to Continental designations S1 & S2.

COLOUR CODE YELLOW

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**VL.23**

this is our grade SV23, well known throughout the engineering industry as general purpose Steel cutting grade, combining a high performance with an extraordinary degree of toughness. It also replaces our grade SH2. Corresponds to Continental designations S2 & S3.

COLOUR CODE MAROON

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an improved version of our grade S69 for heavy or interrupted cutting, giving a performance never encountered in roughing grades. Corresponds to Continental designations S4, S5 or S6

COLOUR CODE CAMBRIDGE BLUE

Veraloy carbide owes its unique combination of performance and toughness to the exclusive manufacturing process used. It is the only cutting tip in the world made by hot pressing and vacuum sintering.

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*V stands for Veraloy, L for grades suitable for material with Long chips. The numbers 1, 2, 3, 4, 5, 6 denote the degree of toughness of the grades, 1 being the lowest, 6 the highest toughness.*

**VERALOY****VERALOY PRODUCTS LIMITED**

BEECH ROAD · THE MARSH · HIGH WYCOMBE · BUCKINGHAMSHIRE  
Telephone: High Wycombe 2795-8      Telegrams: Veraloy, High Wycombe

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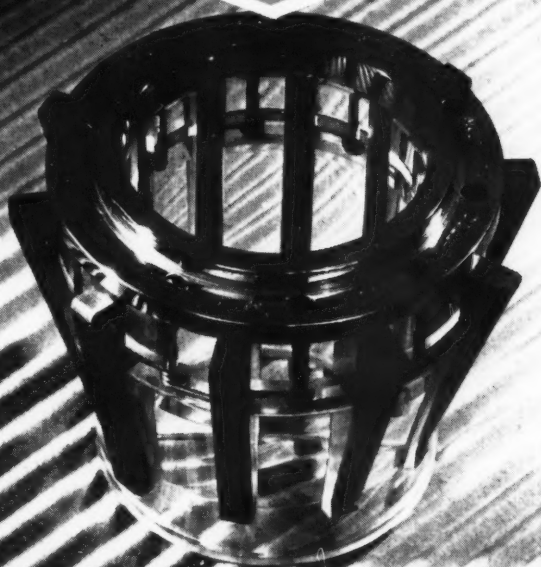
# STAY

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to

this is a "multisize" collet

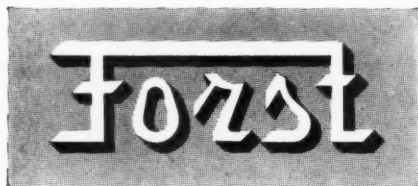


It has a stepless gripping range of  $1/8"$ , equivalent to the gripping capacity of at least ten spring collets. Sizes are available covering a total range from  $1/16"$  to  $2\frac{1}{4}"$ . It is the heart of the "multisize" collet system of workholding and toolholding.

All "multisize" collets in any type range are interchangeable.

to find out more about "multisize" write or phone:—

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**Forst**

**B R O A C H E S**

*are now being made in  
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**We welcome your enquiries for broaches of all kinds, particularly for turbine blades and stainless steel and Nimonic parts.**

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of*

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**E.**

*The fastest method  
of grinding two opposite  
faces*

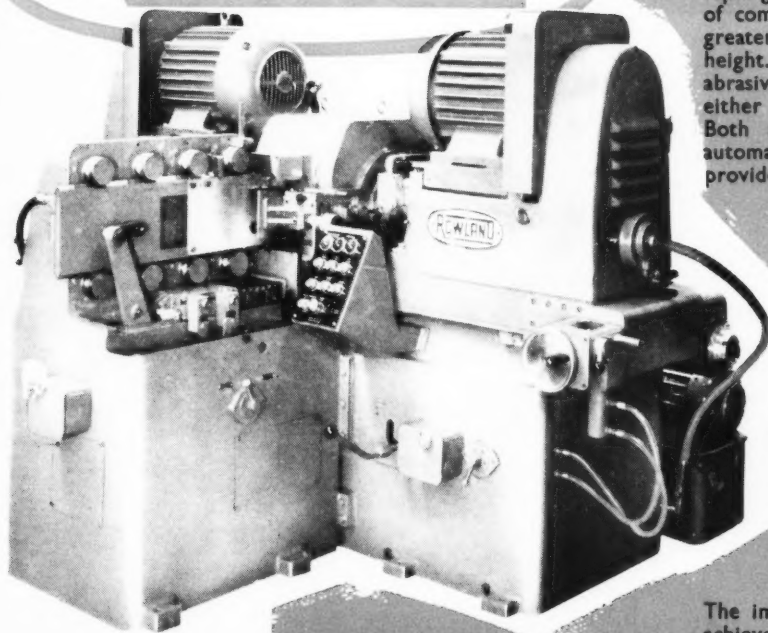
**Duplex  
Surface  
Grinding  
by**

**ROWLAND**



**THROUGH FEED TYPE 'ADD'**

Designed especially for extremely rapid grinding on a continuous basis of components having a width not greater than half their diameter or height. Carries up to 30in. dia. abrasive discs and is available with either 15, 25, 30 or 40 H.P. motors. Both automatic size control, and automatic feeding mechanism can be provided for.



**OSCILLATING HEAD  
TYPE 'HDD'**

For the smaller batches of work where rapid fixture change over time is all-important. A wide variety of components can be ground with heavy stock removal, giving exceptionally accurate results. Available with either 20in. or 30in. abrasive discs, and 20, 30 or 40 H.P. motors.

The impressive rates of production achieved on ROWLAND DUPLEX GRINDERS, coupled with the finish and close tolerances obtained, may well solve a production problem in your own works. Our experience is unrivalled in all spheres of double disc grinding. Why not contact us?

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## AT ACCLES & POLLOCK

### improved results by use of Purolator filters

In drawing  $\frac{3}{4}$ " tubing for refrigerators Accles & Pollock use a specially developed oil in the drawing head.

Purolator bulk filters remove the scale and other abrasives from the oil, and effect a considerable saving in the operations involved.

*In circle: The Purolator filter.*

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AUTOMOTIVE PRODUCTS COMPANY LIMITED  
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At the Engineering,  
Marine, Welding  
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U.S. GOVERNMENT PRINTING OFFICE

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## ROLLS - ROYCE use HARPER CASTINGS

for the gear box and  
steering mechanism  
on the

Silver Cloud Saloon

You are invited to send for Harper's latest illustrated brochure of Castings in grey iron, spheroidal graphite and Meehanite (Regd. trade mark); metal pressings, machining, enamelling and sub-assembly work. On Lloyd's list for S.G. Iron Castings.



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**POOLE FOUNDRY LTD.** Phone: POOLE 212

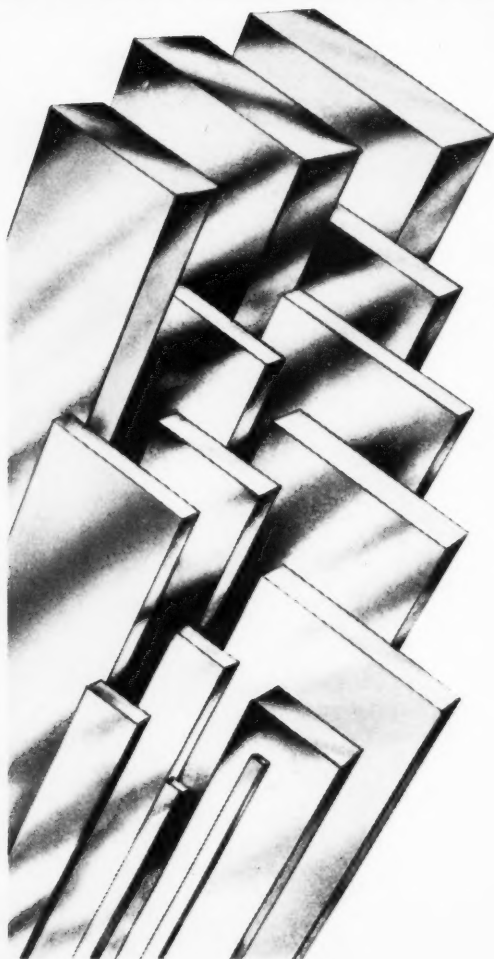
*Also makers of the famous Beatrice Oil Heaters and Harper Housewares*



# MACREADY'S

## BRIGHT STEEL

# FLATS



### USAFLAT

Bright Steel Square-edged flats of good commercial quality with sharp corners, parallel sides and perfect rectangular sections. Size range  $\frac{1}{4}$  in. by  $\frac{1}{8}$  in. to 18 in. by 1 in.

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Carbon Case-hardening Steel Bars are supplied in Bright Drawn or Hot Rolled condition, conforming to British Standard 970: 1955 Specification EN32. Size range 1 in. by  $\frac{1}{4}$  in. to 12 in. by 2 in.

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Bright Drawn Carbon Key Bar B.S. 970: 1955 EN6A. Usakey is supplied in the form of Bright Drawn Steel Bars complying with the material specification of British Standard 46: Part 1: 1958 "Keys and Keyways." Size range  $\frac{5}{16}$  in. by  $\frac{7}{32}$  in. to  $2\frac{3}{4}$  in. by  $1\frac{7}{8}$  in.

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Telephone: TERminus 7060 and 7030 (30 lines)

Telegrams: Usaspead, London, Telex. Telex No. 22788



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*If you want to know something about  
BORING & TURNING MILLS...*




**SEE YOUR  
COMPETITORS!**

If your business requires the boring and turning of medium to large castings and forgings or similar components, and you do not use Webster and Bennett Boring Mills, it's highly probable your competitors do.

In that case, they'll be getting the benefit of lower overheads, because on the bases of capital costs and running costs there are no other machines quite as economical.

Powered for carbide tooling and high metal removal rates; centralised hydraulic controls for operating convenience; easy reserivcing when necessary assisted by unit construction; self-compensating clutches obviating frequent adjustment for wear, are some of the outstanding features of these machines.

Add to this the fact that they are probably the most reasonably priced machines of their kind, and the reasons for their increasing demand become clear.



The illustration shows one of the battery of Webster and Bennett Boring Mills installed in the London Works of Dewrance & Co. Ltd., facing, turning, boring and screwing 5" valve bodies in a floor to floor time of 66 minutes.

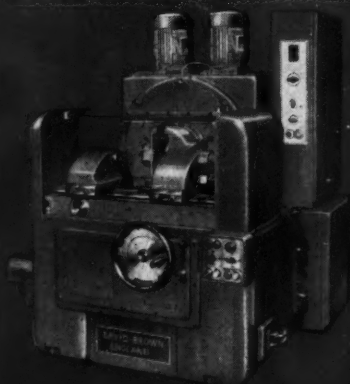


**WEBSTER & BENNETT LTD., COVENTRY, ENGLAND**

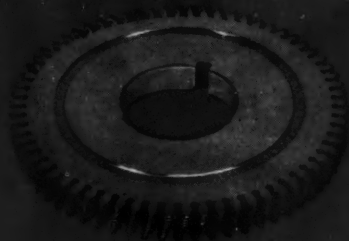
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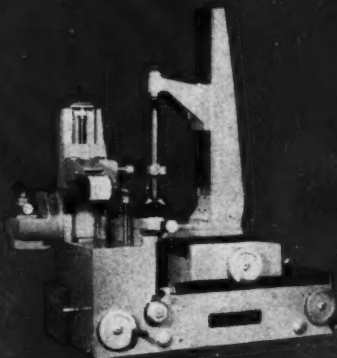
**David Brown MACHINES**



*... with*  
**David Brown CUTTERS**



*... with David Brown*  
**MEASURING EQUIPMENT**



*... for best results!*

## Co-ordinated equipment for maximum efficiency on gear shaving

All your gear shaving and testing equipment from one organisation. The perfect relationship in design and performance, giving peak efficiency at every stage. That's the ideal for best results. And that's what you get when you buy David Brown gear shaving and measuring equipment. David Brown are ready to prove it!

# DAVID BROWN



THE DAVID BROWN CORPORATION (SALES) LTD.

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SHERBORNE STREET, MANCHESTER 3.  
Telephone: BLACKFRIARS 4711.

TOOL DIVISION, PARK WORKS,  
HUDDERSFIELD.  
Telephone: HUDDERSFIELD 3500.

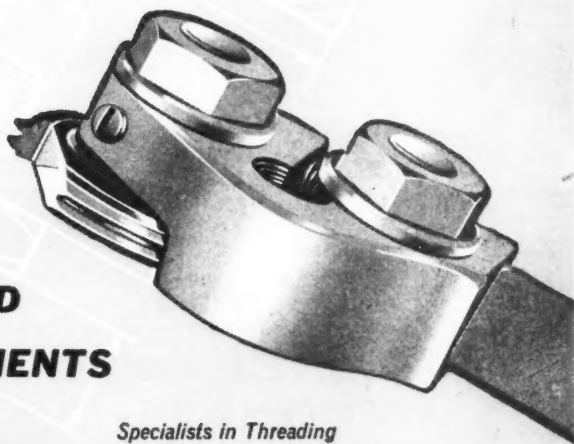
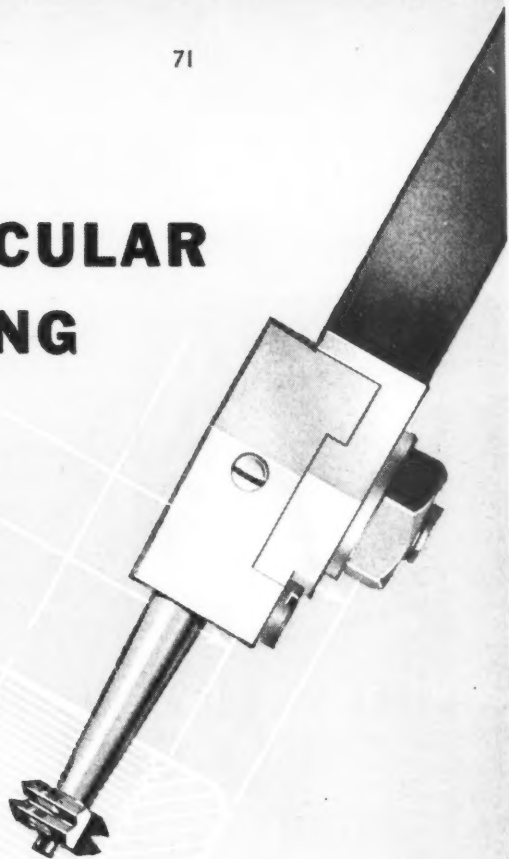
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# **CEJ** CIRCULAR THREAD CHASING TOOLS



**LOW COST TOOLING  
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**CEJ** **JOHANSSON LTD.**

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*Specialists in Threading  
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A METAL INDUSTRIES GROUP COMPANY  
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### ADJUSTABLE CENTRE MULTI-DRILL HEADS



#### "V" SERIES UNIVERSALLY ADJUSTABLE CENTRE MULTI-DRILL HEADS

Made in four sizes to suit either medium or heavy drilling requirements—quick adjustment—positive locking.

- ★ Hard Light Alloy Body
- ★ Hardened and Ground Gear Drive
- ★ Ball Type Universal Joints
- ★ Anti-Friction Bearings
- ★ Bush Lugs provided for Guide Rods
- ★ Spindles run at the same speed and direction as the drilling machine spindle.

High quality product designed and made for continuous productive service.

#### "M" SERIES ADJUSTABLE MULTI-HEADS

Made in 12 Models to cover wide range of application.

**ROBUST - COMPACT  
- TOTALLY ENCLOSED**

- ★ Rapid positive adjustment: simply slacken Central Locking Screw, turn spindle to desired position and re-lock.
- ★ Minimum of rotating parts.
- ★ Positive Drive by Heat Treated Gears.
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- ★ Light Alloy Bodies with Lugs for Guide Bars.
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- ★ Silent operation.



**Drillmax Division, Leighswood Works, Leighswood Road,  
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Telephone: Aldridge 52439.**

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# For better service from any air line



Any air control system incorporating cylinders and valves, or which operates tools and equipment, will give better service if the air is properly filtered, the pressure is regulated to the job and adequate lubrication is provided. The Schrader LUB-AIR-ATOR is a combination of three units which perform these functions automatically, ensuring better and

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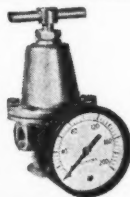


## AIR LINE FILTERS

Clean the air supply of rust, dirt and moisture. Sintered bronze filter unit, whirling action baffle plate and bowl, easily cleaned without disturbing piping.

## AIR PRESSURE REGULATORS

Reduce and maintain line pressures to the actual requirements at any point. Outstanding for higher capacity, faster response and lower pressure drop under loading.



## AIR LINE LUBRICATORS

Provide lubrication protection for cylinders, valves and pneumatic equipment. External flow adjustment. Visible oil level. Refilled without shutting off the air.



# Schrader

LUB-AIR-ATOR

*\*Another product of Schrader design and workmanship.*

**Send TODAY for details of this outstanding Schrader development**

To: A. SCHRADER'S SON, Air Control Products Dept. M 829 TYBURN ROAD, ERDINGTON, BIRMINGHAM, 24

Please send details of Schrader LUB-AIR-ATOR

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ADDRESS.....

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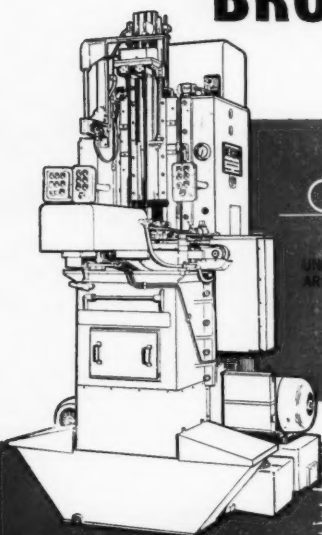
# AUTOMATION in BROACHING!



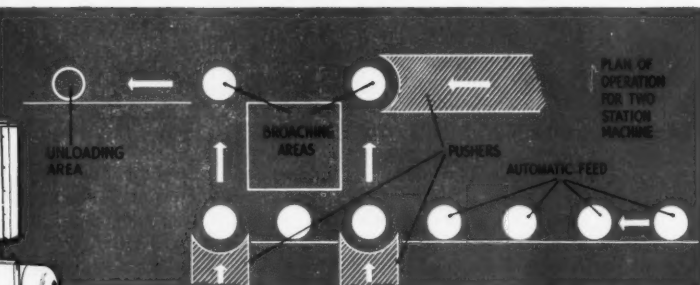
MULTI-STATION

## VERTICAL PULL DOWN BROACHING MACHINES

- ★ AUTOMATIC TOOL HANDLING
- ★ AUTOMATIC WORK HANDLING

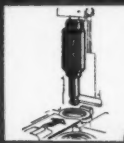
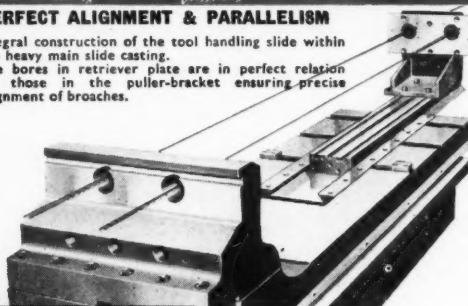


**PULL<sup>®</sup> DOWN PRINCIPLE**  
*ensures*  
**BETTER FINISHES**  
**BETTER TOLERANCES**  
**BETTER TOOL LIFE**

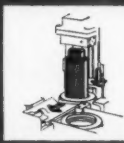


### PERFECT ALIGNMENT & PARALLELISM

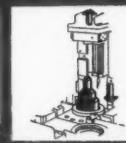
Integral construction of the tool handling slide within the heavy main slide casting. The bores in retriever plate are in perfect relation to those in the puller-bracket ensuring precise alignment of broaches.



Part automatically positioned. Broach suspended.



Retriever lowered. Broach engaged in puller.



Broach passes through work; disengages from retriever when finish teeth have cleared the work.



Part automatically ejected. Broach returning to upper bracket.

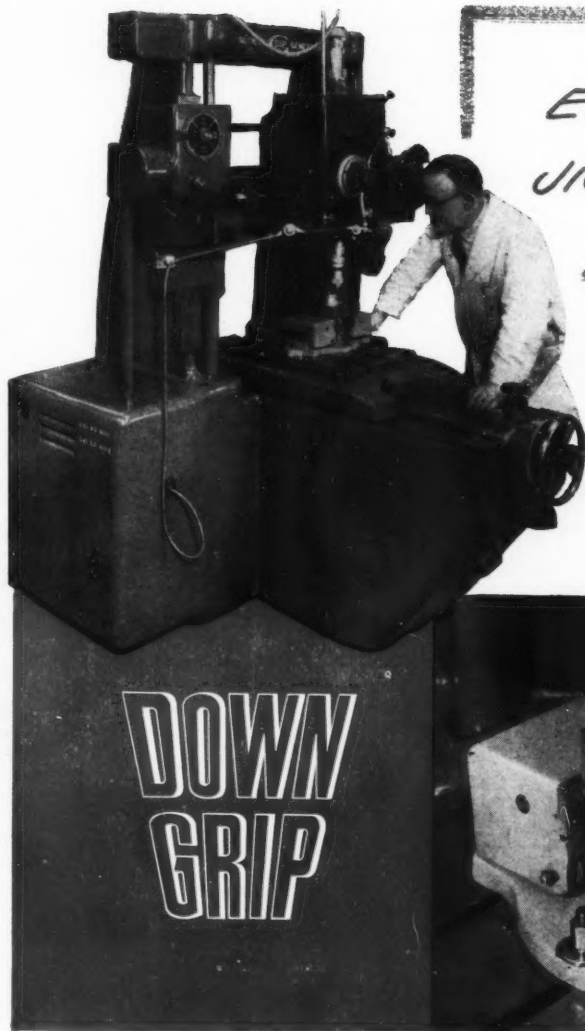
**B.S.A. Detroit pull down machines** have every feature for ease in operation and accurate production: automatic tool handling, unique and accurate guidance of broaches, continuous engagement at both puller and retriever end, single or multi-station operation, positive lubrication.

**Standard capacities:**  
5 tons, 30in. stroke, 35 F.P.M., to 50 tons, 72in. stroke, 20 F.P.M. (Cutting speeds variable.)

May we supply further details?

**B.S.A. TOOLS LTD., BIRMINGHAM, 33, ENGLAND** Cables: Nadricot Birmingham  
**SOLE AGENTS G.T. BRITAIN · BURTON GRIFFITHS & CO. LTD., KITTS GREEN · BIRMINGHAM · STECHFORD 3071**

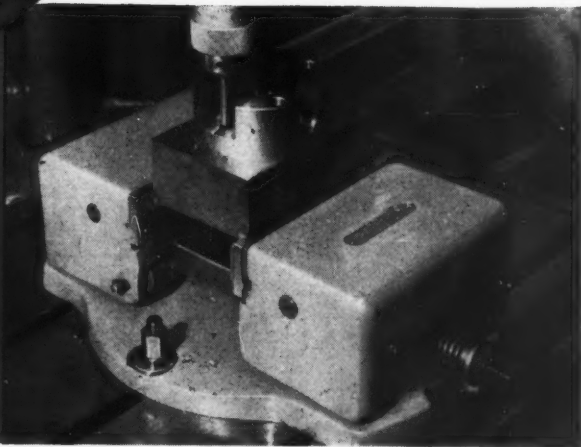
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*EVEN ON A  
JIG BORER...*

Here is a Machine Vice with built-in precision. As its name implies, it actually grips the work hard down on to its table or parallels. An accurate set-up in seconds!

The illustrations show the boring of a location pin hole in a fuel pump assembly fixture at the premises of Messrs. AC-Delco, Liverpool, by whose courtesy the photographs are reproduced.



**DOWN  
GRIP**

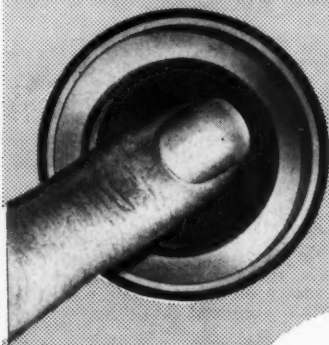
\* *BUILT AS A MACHINE TOOL — FOR EFFORTLESS PRECISION*

**THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED**  
SHEFFIELD ENGLAND

DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS

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# START...NEW efficiency



ensure  
*velvet-smooth  
starting, stopping  
positioning and  
tensioning*

achieve  
*complete electrical  
integration of  
machine drives  
and controls*

eliminate  
*complex  
equipment*

lessen  
*operator  
fatigue*

widen  
*scope for  
machine  
design*

**INSTALL  
THESE  
COMPACT  
SPACE-  
SAVING  
UNITS**

## **WARNER** ***Electric Brakes and Clutches***

### **MORE CONTROL — MORE PRODUCTION**

Warner *Electric Brakes and Clutches* completely integrate power transmission with electrical or electronic machine control circuits. Electric Brake units eliminate coasting, save non-productive machine time; electric clutches operate rapidly in any position and give smooth engagement. Warner electric units are easily installed—on new or old-type machines. Their superior performance is directly responsible for greater production in many varied industries—very probably in yours!

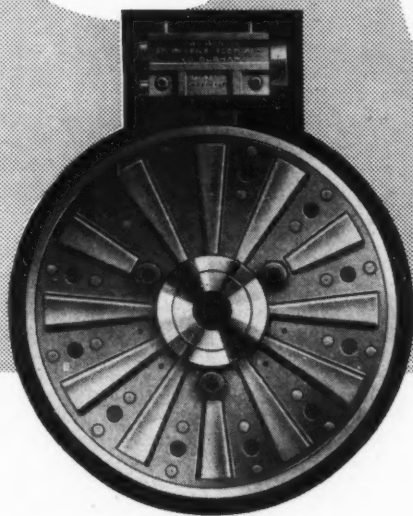
*Write for illustrated Warner brochure*

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*When answering advertisements kindly mention MACHINERY.*

# y of machine control

*reduce  
brake and  
clutch maintenance  
and reduce servicing  
of actuated  
devices*



## ST. HELEN'S AUCKLAND CO. DURHAM

Telephone: West Auckland 551 (6 lines)

Telegrams: Solenoid, West Auckland

LONDON:

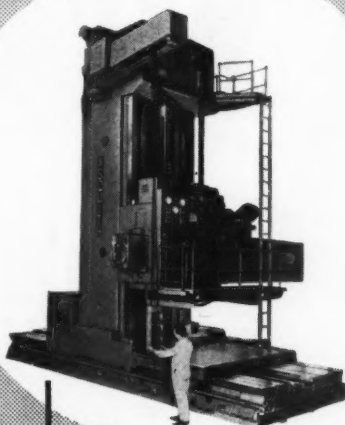
2 Ashley Place, Carlisle Place, London, S.W.1

Telephone: VICTORIA 7301/2

BIRMINGHAM:

Silhill Hse., 2241 Coventry Rd., Sheldon, Birmingham 26

Telephone: SHELDON 5121/2



This Asquith Ram Type Horizontal Milling & Boring Machine, with 6" dia. spindle, incorporates Warner Clutches for speed change of the feed drive.

Reproduced by courtesy of  
William Asquith Ltd.,  
Halifax.

*Other well-known users of  
Warner Electric Brake & Clutches  
include:*

BROOKE TOOL AUTOMATION LTD.

B.S.A. TOOLS LTD

CHURCHILL-REDMAN LTD

CHURCHILL GEAR MACHINES LTD

CRIVEN BROTHERS (MANCHESTER LTD

DAVID BROWN INDUSTRIES LTD

(Machine Tool Division)

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**NEW**

**HIGH-SPEED STEEL  
SCREW SHANK  
END MILLS**  
(WITH EXCLUSIVE TOOTH FORM)

**MILLING**

**HIGH-SPEED STEEL  
SCREW SHANK  
SLOT DRILLS**  
(WITH EXCLUSIVE TOOTH FORM)

**TOOLS!**

**THE  
'TITANIC'  
CHUCK**

(INCORPORATING MANY  
NEW DESIGN FEATURES)

**OSBORN**

The superior design of these products is the result of prolonged research and development. They are far in advance of similar tools of comparable price and much faster speeds and feeds are achieved with the cutters.  
Please write for leaflet No. 11 "An Advance in Milling".

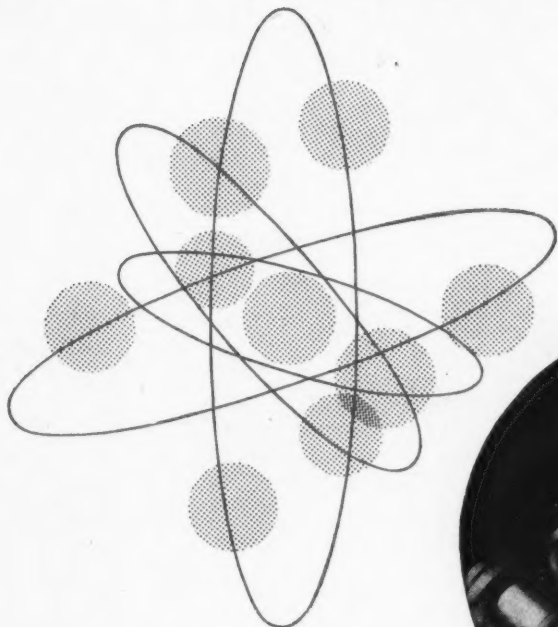
★ Comprehensive stocks  
constantly maintained

**SAMUEL OSBORN & CO., LIMITED**  
**CLYDE STEEL WORKS · SHEFFIELD**  
*Fine Steelmakers · Steelfounders · Engineers' Toolmakers*

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## **I'm a versatile type**

.....I'm a Renold precision roller chain—the most versatile transmission medium yet invented. Like a molecule of iron—the most versatile element in industry—I'm everywhere. Industry can't do without me and every day more and more problems are being solved by my imaginative application.

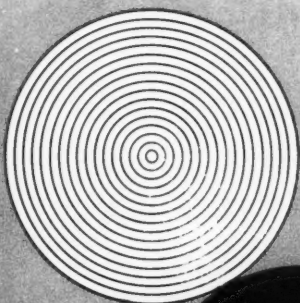
# **RENOLD CHAINS**

versatile      durable      efficient



**RENOLD CHAINS LIMITED • MANCHESTER**

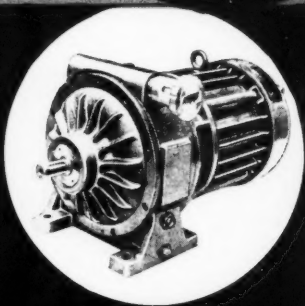
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- ▶ Range  $\frac{1}{33}$  h.p. to 15 h.p.
- ▶ 9 to 1 stepless speed variation.
- ▶ Flange mounted motors (when required).
- ▶ Flange mounted Reduction Gears for low output speeds.
- ▶ Exceptionally light, sensitive, and accurate control of speed settings by handwheel, pneumatic, mechanical or electrical remote control.

*Technical  
Representatives  
in*

LONDON  
BIRMINGHAM  
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**CONTROLLED VARIABLE SPEED**

**ALLSPEEDS LIMITED**

Royal Works · Clayton-le-Moors, P.O. Box 43, Accrington, Lancashire · Telephone Accrington 35441 (6 lines)

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collet troubles  
on high-speed  
automatics?

decarburised surface areas  
on black rolled stock?

heavy machining costs  
due to irregular surface?

high tool-room costs in  
making punches,  
dowels, ejector pins, etc?

LET **KE** SOLVE YOUR PROBLEMS . . .

by using drawn  
and ground

**KE** SPECIAL STEELS

Supplied in lengths, drawn and centreless ground, 1" — 2" diameter, within close tolerance of size, KE Special Steels are available in a wide range of High Speed, Tool, Stainless and Alloy Steels, including such qualities as

**KEA 100** Free Machining 1% Carbon Silver Steel,

**KE 40 A M** Free Machining Stainless Iron.

Both the above qualities give great increases in machining speeds.

**KE** Electrically melted Silver Steel, to B.S.S. 1407.

**KE LOCK 237** 18% Tungsten Vanadium High Speed Steel (18/4/1).

**KE 839** 1% Carbon 1½% Chrome Oil Hardening Alloy Tool Steel.

**KE 805** Direct Oil Hardening Nickel Chrome Molybdenum Steel.

We specialise in the supply of material for work demanding high grade steels, regular in quality and performance, and accurately drawn and centreless ground to size.

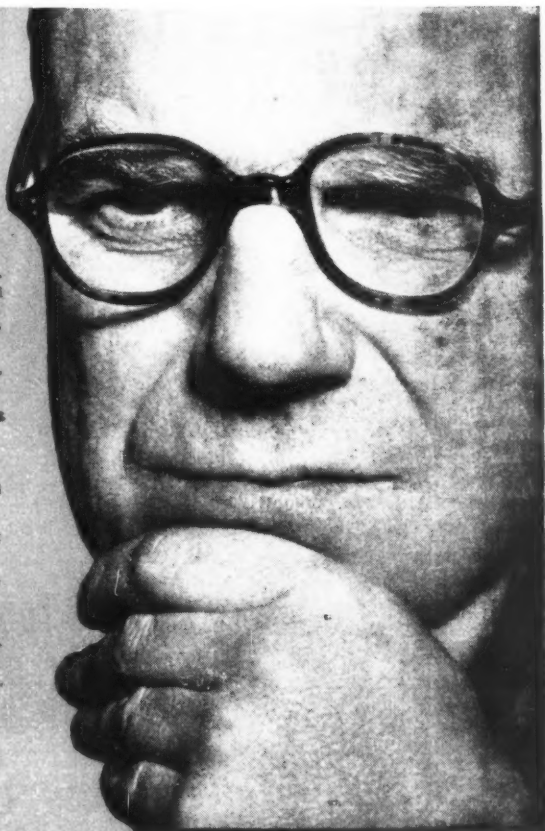


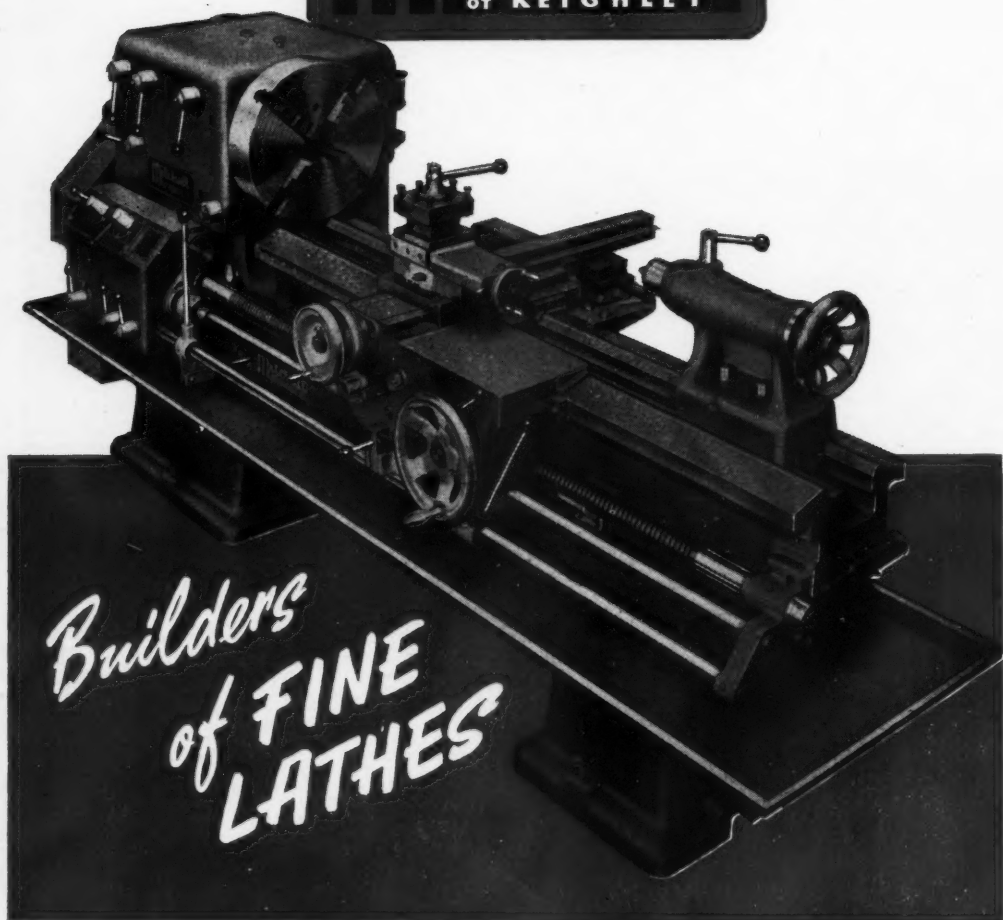
This booklet, giving greater detail, is available free on request.

**KAYSER ELLISON & CO. LTD**

TELEPHONE: SHEFFIELD 22124 ESTABLISHED 1825  
CARLISLE STEEL WORKS • SHEFFIELD

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## FROM 6 $\frac{1}{2}$ " TO 16 $\frac{1}{2}$ " HEIGHT OF CENTRES

These machines are built out of a long tradition of craftsmanship to the highest modern standard of design, productive capacity and precision. There are sizes and types to meet your own needs. Ask us to send you details.

**MANUFACTURERS: D. MITCHELL & CO. LTD., KEIGHLEY, YORKS**  
Telephone: Keighley 4283

London and Export Office:

**MORRISON, MARSHALL & HILL LTD., TOWER HILL, LONDON, E.C.3**  
Tel: Royal 1461 Cables: Morimil, London Grams: Morimil, Fen London

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*Longer runs for your money..*



# FMP 336

## A SUPER GRADE SPECIAL ALLOY STEEL

FOR BLANKING AND FORMING DIES  
PLASTIC MOULDS, PUNCHES  
THREAD ROLLING DIES, GAUGES  
LATHE CENTRES, ETC.

FMP 336 is a really dependable special alloy steel possessing exceptional resistance to wear. It is easy and safe to harden and usually eliminates cracking hazards on intricate dies, thin sections, short radii, etc.

Supplied in rounds, squares and flats as well as in rings and forgings.

# F.M. PARKIN • (SHEFFIELD) LTD

ST. THOMAS STEEL WORKS, SHEFFIELD, 8, ENGLAND  
PHONE: SHEFFIELD 50083 (5 lines) • GRAMS: SORBITIC SHEFFIELD, 8  
and Offices and Warehouses at Chapel St., Booth St., Handsworth, Birmingham. Tel: Northern 9707  
and 6/9 Red Lion Market, Whitecross St., Finsbury, London, E.C.1. Tel: Monarch 9102



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# Spectra -Spray

## TOOL ROOM BLUE

*Spectra Color Blue - In the Speedy Aerosol Pack*



Spectra-Spray is a Tool Room MUST—the up-to-date answer to all marking problems. It cannot spill, leak or evaporate; dries in seconds in a film which will not smudge, chip, crack or peel, is impervious to water, oil or petrol and is permanent until machined off or removed with Spectra-Remover.

Spectra-Spray is by the makers of Spectra-Color Layout and Identification fluid. Full details of these and all other products gladly sent on request.

### SPECTRA CHEMICALS LIMITED

Spectra Works, High Street, Caterham, Surrey.

Telephone: Caterham 3182 & 2293

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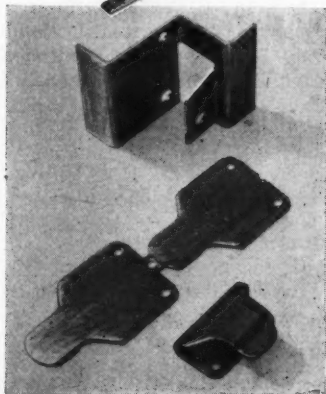
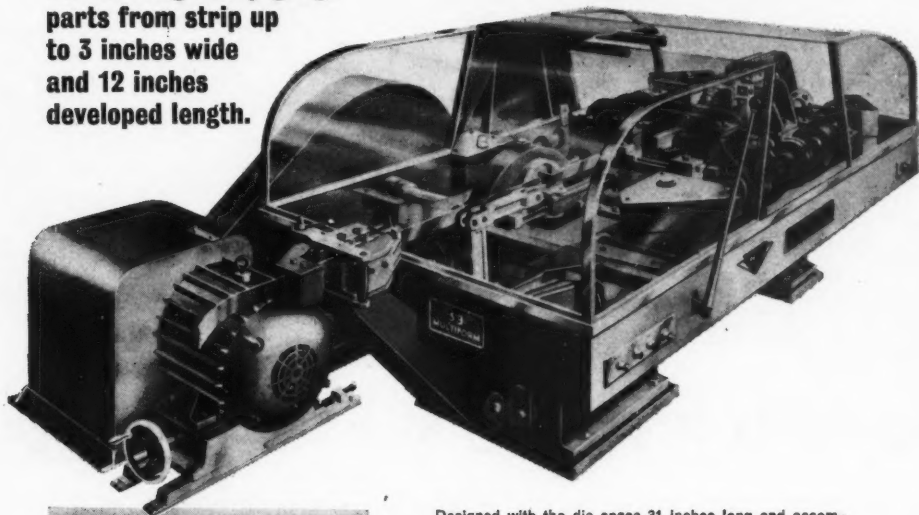




# HEENAN *Multiform*



**For forming heavy gauge parts from strip up to 3 inches wide and 12 inches developed length.**



Designed with the die space 31 inches long and accommodating three individually operated diesets, if required, each 10 inches long, the Heenan S.3 Multiform is particularly suitable for the automatic forming of parts requiring substantial presswork, such as piercing, stamping, coining, blanking, embossing and trimming, using progression tooling. Press rams can be operated from front or rear, with 30 tons loading to each ram.

Output rates are variable from 40 to 120 parts per minute. The machine is particularly robust and has been designed to cater for the particularly heavy loads exerted when working on heavy gauge strip.

*If fast multi-forming is new to your Company you may freely borrow a 16 m.m. colour film "The Heenan Multi-form" which fully describes the technique. Write sole agents below.*



**WICKMAN**



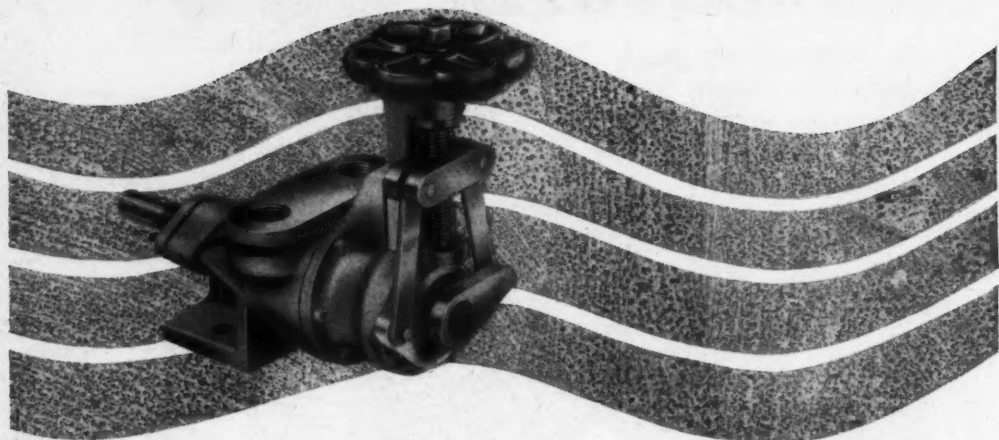
**LIMITED**

FACTORED MACHINE TOOL DIVISION, BANNER LANE, COVENTRY. Tel. TIII 65231

002 F82

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F



## versatility in pumping with the Rotoplunge...

The perfect pump for use with all lubricant fluids of a non-abrasive nature which, because of its versatility, is ideal for a wide variety of industries. Long life and reliability are built into the unique construction of the Rotoplunge, which has only three moving parts. *No other range of pumps has such a wide variety of optional features.*

### **VARIABLE STROKE**

Gives infinitely variable control over the complete range with accurate indication of the setting.

### **SHORT STROKE**

End covers providing for reduced delivery ratios of one third and two thirds are available as an alternative to variable stroke.

### **AUTOREVERSE**

Irrespective of the direction of the driving shaft, the autoreverse automatically maintains a uniform direction of flow.

### **RELIEF VALVE AND BY-PASS**

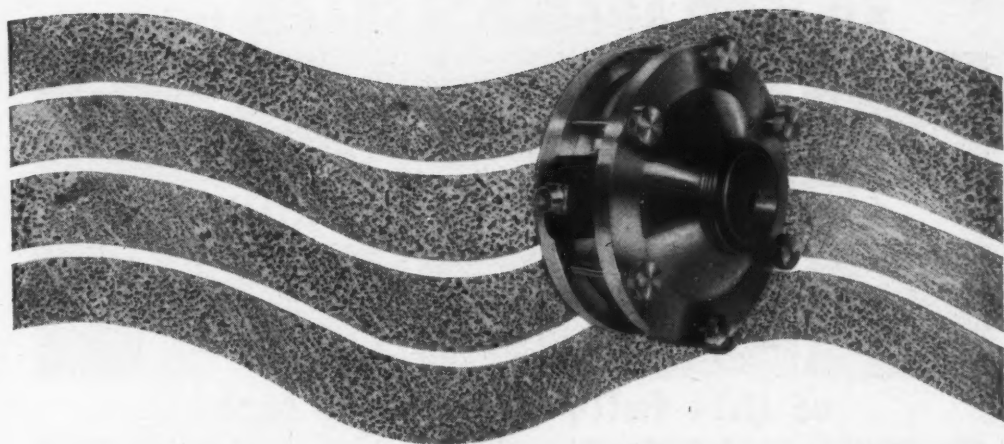
All pumps can be fitted with a relief valve and by-pass to prevent overloading of the pump or driving arrangement.

### **WIDE RANGE**

Available in a comprehensive range from 7.5 to 2,300 gal/h. Flange or foot mounted for close-coupled or motorised sets. *The illustration shows a foot mounted Rotoplunge pump with variable delivery control.*

Write for Brochure N1/M4

When answering advertisements kindly mention MACHINERY.



## ...and in metering with the Unipulse

The finest system for accurately metering continuous flow or for batch control of liquids used in almost every industry including food, drink, chemicals, plastics and oil. It can be used as a primary measuring device for computing and read-out systems.

### **VARIETY OF LIQUIDS**

The Unipulse will accurately indicate the rate of flow and dispense batches of liquids of differing viscosity, acidity, alkalinity and temperature.

### **ACCURACY**

The action of the Unipulse is to electromagnetically count the revolutions of a piston, eliminating the use of gears, stuffing boxes, etc. Thus with only one moving part the Unipulse is extremely reliable at all rates of flow, with an accuracy of  $\pm 0.25\%$  at a constant rate of flow which is unaffected by changes in viscosity.

### **EASE OF INSTALLATION**

Unipulse can be easily and quickly installed into existing pipe-lines in flows ranging from 5 to 12,500 gal/h.

Write for Brochure N2/M4

## **PARKINSON COWAN MEASUREMENT**

*A division of the Parkinson Cowan Group*

TAMESIDE WORKS • DOBCROSS • OLDHAM • LANCASHIRE • TELEPHONE: DELPH 424



**All these different tooling setups**



**show the amazing versatility**



**of this fully automatic lathe**



**..the SIMPLIMATIC**



Here's versatility that beats any automatic lathe you ever saw! Actually, the Simplimatic is doing hundreds of jobs like these—jobs that would otherwise be put on *special* machines—built at extra-special cost. But this (and don't miss the important point!) is a *standard* machine—at a *standard* price.

If you have medium or long runs on parts up to 33½" in diameter, get the facts about the Simplimatic Automatic Lathe.

**GISHOLT**  
MACHINE COMPANY

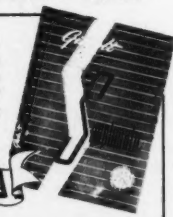
TURRET LATHES • AUTOMATIC LATHES  
SUPERFINISHERS • BALANCERS • SPECIAL MACHINES



**THE GISHOLT ROUND TABLE**

represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here

THIS CATALOGUE may show you how the Simplimatic can save you money. Write for your copy to the sole selling agents.

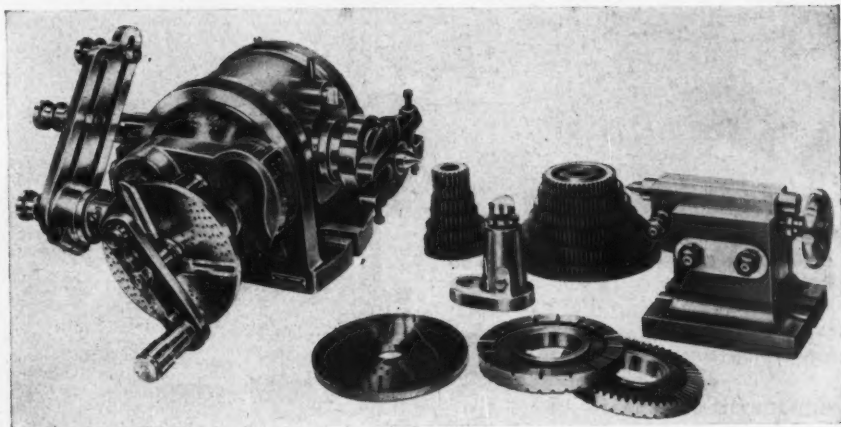


FACTORED MACHINE TOOL DIVISION  
BANNER LANE COVENTRY

Telephone: Tile Hill 65231

# COS-PAR

## HIGH PRECISION UNIVERSAL DIVIDING HEADS MODEL ALFA



SPECIFICATION	ALFA 1	ALFA 2	ALFA 4	ALFA 5	ALFA 7	ALFA 9
HEIGHT OF CENTRES ... ..	4½"	5½"	5½"	6½"	7"	7½"
BORE OF HOLLOW SPINDLE ... ..	⅝"	1 ⅛"	1 ⅛"	1 ⅛"	1 ⅛"	1 ⅛"
MORSE TAPER IN SPINDLE ... ..	No. 3	No. 4	No. 4	No. 4	No. 4	No. 4
MORSE TAPER IN TAILSTOCK... ..	No. 1	No. 2	No. 2	No. 2	No. 2	No. 2
DIVISION RATIO ... ..	1 : 40	1 : 40	1 : 40	1 : 40	1 : 40	1 : 40
DIVISIONS OBTAINABLE... ..	2-400	2-400	2-400	2-400	2-400	2-400
APPROXIMATE WEIGHT... ..	114 lbs.	161 lbs.	255 lbs.	260 lbs.	270 lbs.	280 lbs.
PRICE ... ..	£160	£180	£250	£275	£295	£310

**SPECIAL TERMS TO MEMBERS OF B.A.M.T.M.**

**HERBERT WIDDOWSON & SONS LIMITED  
CANAL STREET WORKS NOTTINGHAM**

TELEPHONE: 51891 (3 lines)

TELEGRAMS: TOOLS NOTTINGHAM

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# TEST 2

A NEW UNIVERSAL MILLING MACHINE

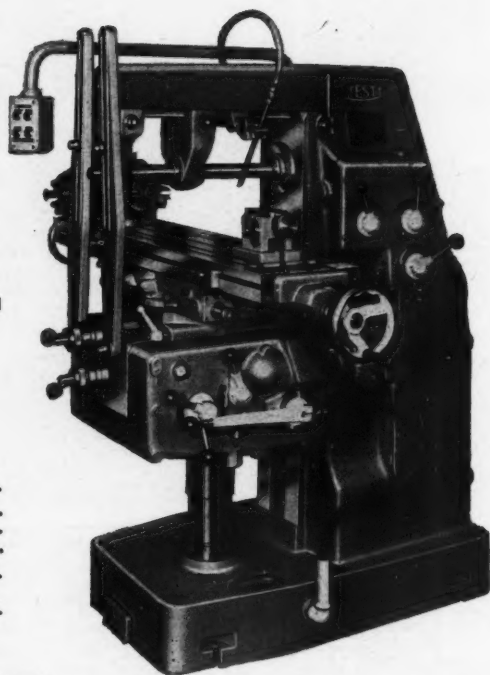
FOR IMMEDIATE DELIVERY.

With these salient features:—

- ★ Hardened and ground gears
- ★ Power feeds and Quick Power Traverse in all directions
- ★ Speeds up to 2,000 r.p.m.
- ★ Electro Magnetic Clutch
- ★ Backlash Eliminator

## BRIEF SPECIFICATION

Table:	Working surface	..	48in. by 11in.
Table Feeds:	Longitudinal	..	29in.
	cross (without brace)	..	9in.
	vertical	..	17½in.
Spindle:	Spindle Nose	..	No. 40 N.S.
	18 speeds	..	40 to 2000 R.P.M.



STANDARD EQUIPMENT—COS-PAR Dividing Head

Vertical Milling Attachment  
Arbor, Front Braces Coolant  
Equipment etc.

See the whole TEST  
Range at our works.

Special terms for B.A.M.T.M. Members. Price £1,825.

## HERBERT WIDDOWSON & SONS, LIMITED

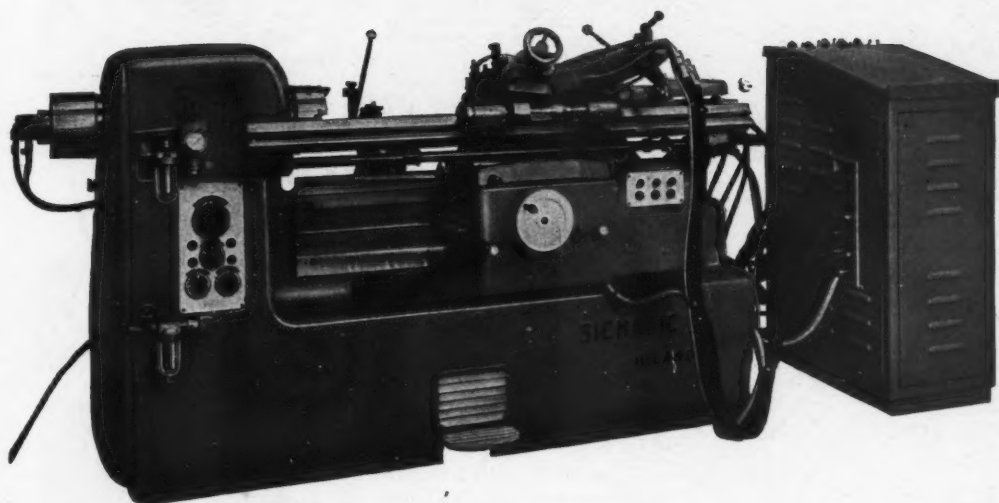
Canal Street Works, Nottingham. Tel: 51891 (4 lines) Grams: TOOLS, NOTTINGHAM

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The

**NEW**

**SICMATIC**



**Automatic  
and  
Semi-Automatic  
Hydraulic  
Profiling  
Lathes**

**7**

**POINT FEATURES INCLUDE**

- 1 Capacity.
- 2 Duplomatic Hydraulic System.
- 3 Hardened Bed Slideways.
- 4 Auto cycling up to six depths of cut.
- 5 Hydraulic tailstock for drilling and boring.
- 6 Uses template or existing component.
- 7 Eight models to choose from.

**Basic price under £2,000.**

**Specification**

Bore of spindle	..	..	2 1/2 in
Spindle nose	..	5 in. A.S.A.	
Max. swing over bed	..	..	15 1/2 in.
Max. swing over saddle	..	..	9 1/2 in.
Max. length turned	..	..	27 1/2 in.
Hydraulic traverse of copying slide	..	..	4 in.
Hydraulic feed of tailstock spindle	..	..	4 1/2 in.
Number of feed rates to copying slide	..	..	48
Max. tool pressure	..	1,300 lbs.	
Approx. nett weight	..	5,000 lbs.	

**QUICK DELIVERY**

Daily demonstrations at our works

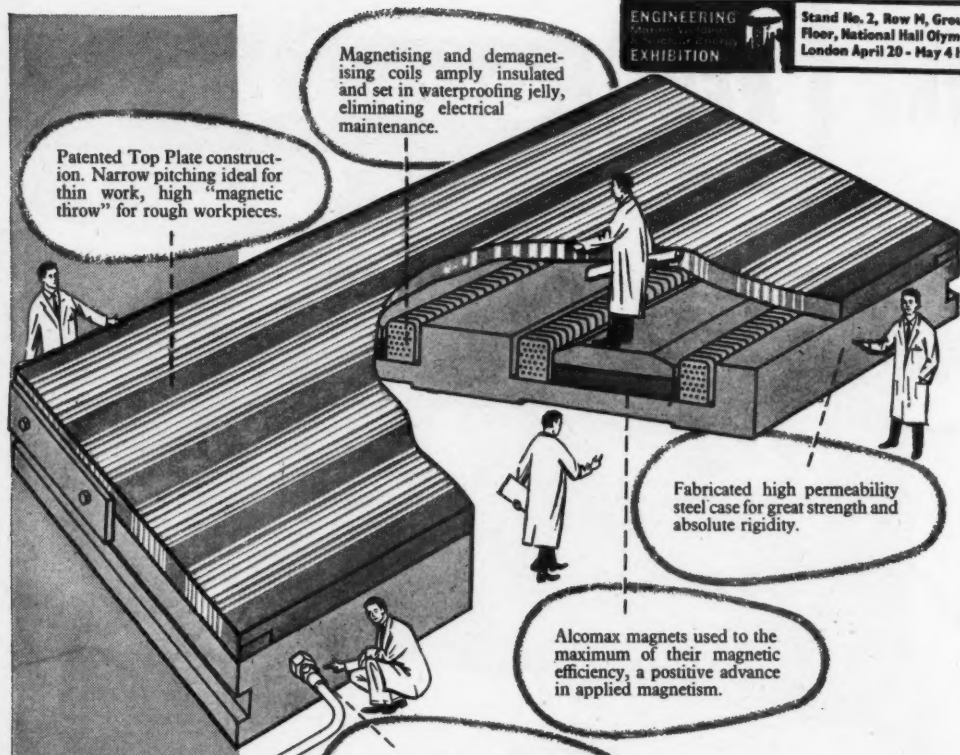
**HERBERT WIDDOWSON & SONS LTD**

Canal Street Works, Nottingham

Telephone: 51891 (4 lines) Telegrams: TOOLS NOTTINGHAM



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ENGINEERING  
Machinery  
EXHIBITION

Stand No. 2, Row M, Ground  
Floor, National Hall Olympia  
London April 20 - May 4 1961



## permanent-electro magnetic chucks

Even more magnetic holding power for large stock removal.

Maximum safety, current is only required to switch on and off.

Complete accuracy—no distortion through heating—no moving parts.

*Ask for fully detailed literature.*

**ECLIPSE—the first name in Magnetic Tools**

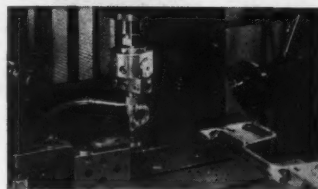
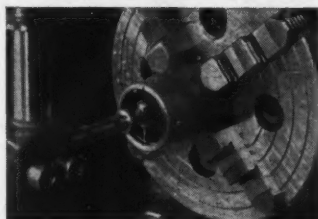
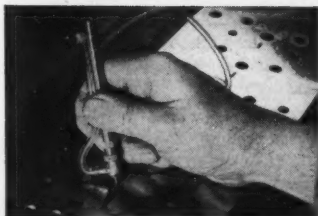
MADE BY JAMES NEILL & CO. (SHEFFIELD) LTD. and available through your usual Eclipse dealer

THE  
**ASHCOMBE**  
 INDUSTRIAL  
**AIROTOR**  
 is here!

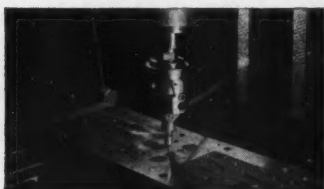


**300,000 RPM**

**A revolutionary industrial tool for ultra high speed removal of metal and other materials to precision tolerances.**



The Ashcombe Airtor is an air-driven instrument operating at a spindle speed in excess of 300,000 r.p.m. This speed develops the full efficiency of small carbide burrs in a field never before used or known. It is possible now to machine the very hardest tool steels, carbides, ceramics, chrome, glass, plastics etc. to close tolerances using inexpensive carbide, diamond and abrasive tools. The high operating speed dissipates all heat from the instrument and from the material being worked, and there is no tendency for the burr to 'climb'. The Ashcombe Airtor can be used as a hand tool, or easily adapted for use with Jigborers, Lathes, Milling Machines, Pantographs or in special 'set-ups'. The Airtor head itself is only  $\frac{3}{8}$ " diameter and  $\frac{1}{2}$ " long, allowing the instrument to reach into confined spaces and openings. A full range of tungsten carbide burrs and diamond mounted points are available for use with the Ashcombe Airtor, which can be operated from an airline providing a pressure of 40 lbs. p.s.i.



**W. J. MEDDINGS LIMITED**

SPECIAL PURPOSE DIVISION  
 IPSWICH ROAD · TRADING ESTATE · SLOUGH · BUCKS  
 Phone: Slough 26761 (5 lines)  
**Sole selling agents in Europe**

*Here's precision plus—  
at the right price!*

YOU'LL BE 100% SURE OF IT WITH A

**MEDDINGS**  
*Pacera*

#### MF5 Mk II DRILLING MACHINE 1" CAPACITY

MF5 Mk II—here's your codeword for accurate, economic drilling! Everything about this robust job adds up to just that! And what other machine offers such a specification at a comparable price?

Solid construction throughout means you've got real stability. The column is solid steel, 3½" diameter, and is ground all over. An oil immersed gearbox, totally enclosed in the Drill Head, gives eight spindle speeds (range 80-1,500 r.p.m.). Throat depth 9". Choice of High or Low speed setting for each of four Vee belt positions, thanks to accessible gear change lever with positive action.

**1.** Complete rigidity from No. 3 M.T. taper (internal type).

**2.** Maximum rigidity again from the extra large drill table-ground working surface is over 225 sq. in., and you have rack and pinion for raising and lowering, and ample coolant trough.

**3.** Friction/clutch type Depth Stop—integral with star wheel—has graduated scale for accurate depth drilling.

**Price**  
**£132.00**

Coolant equipment and  
chuck guard extra

#### IDEAL FOR MULTI-SPINDLE DRILLING TOO

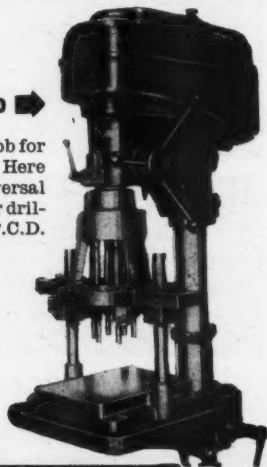
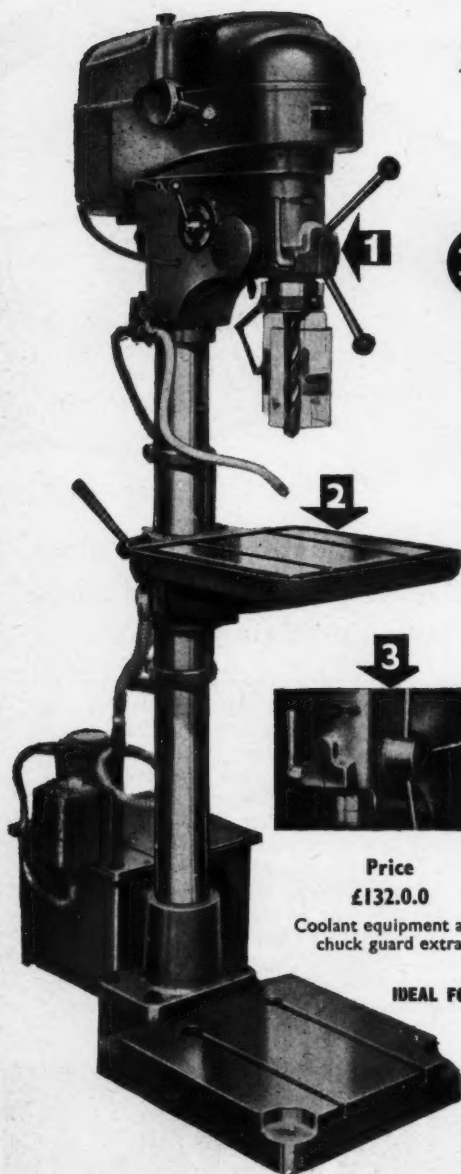
The MF5 Mk II is just the job for light multi-spindle work. Here you see it fitted with a universal type multi-spindle Head for drilling up to a maximum P.C.D. of 6".

Write for particulars to the Makers:

**W. J. MEDDINGS LTD.**

IPSWICH ROAD, TRADING ESTATE, SLOUGH, BUCKS.  
TELEPHONE: SLOUGH 26761 (5 LINES)

When answering advertisements kindly mention MACHINERY.



**MATHEYS****JIG BORER****Model 3A/2**

To offer "Tenths Accuracy" at lowest cost and bring the jig boring machine within reach of most workshops has been the idea behind the conception and creation of these Belgian manufactured Jig boring Machines. The simple and ingenious mechanical principles, the high precision of the essential parts, and the omission of unnecessary details have resulted in the success of this model.

- Head traverse by separate motor with end safety switches.
- Single lever combined for sensitive spindle feed and engagement of clutch for power spindle feed in both directions.
- Reading of the traverse movements by projectors and dials, on high precision scales chromed, with superfinished and finely graduated surfaces.

**DELIVERY  
FROM  
STOCK**

We can demonstrate this model in our own plant and welcome visitors for this purpose.



Sole Selling Agents in Great Britain, etc.

**A. A. JONES & SHIPMAN LTD.**

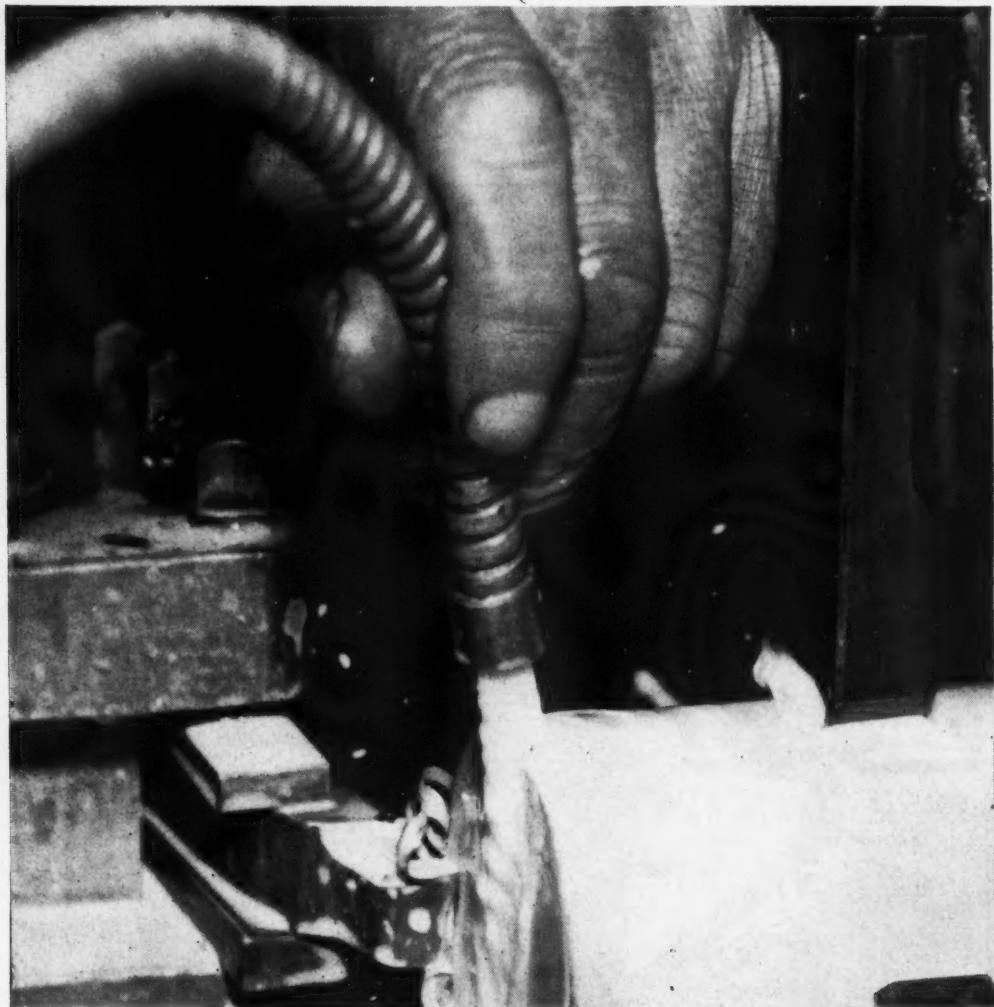
LEICESTER Tel.: 823222.

LONDON OFFICE: 50-52 GREAT PETER STREET, LONDON, S.W.1.

Tel.: ABbey 5908-9

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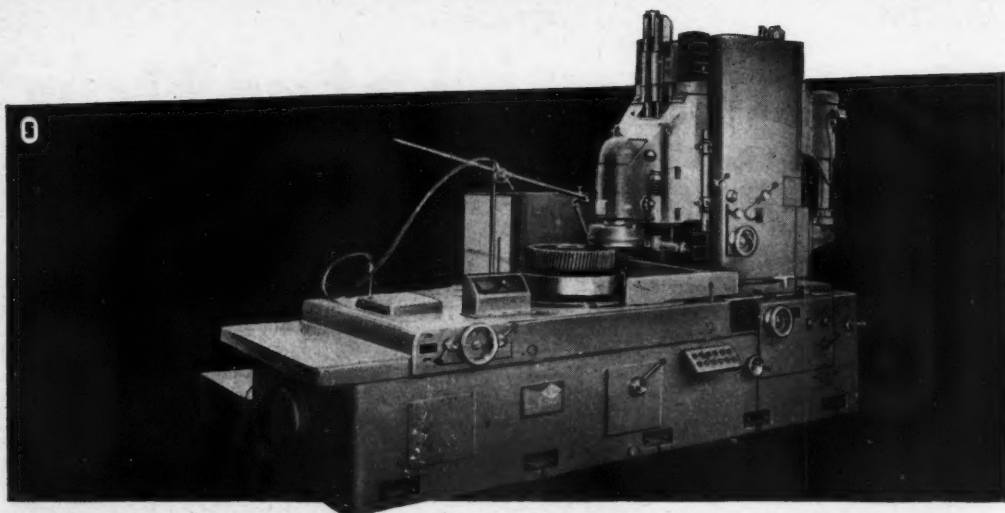
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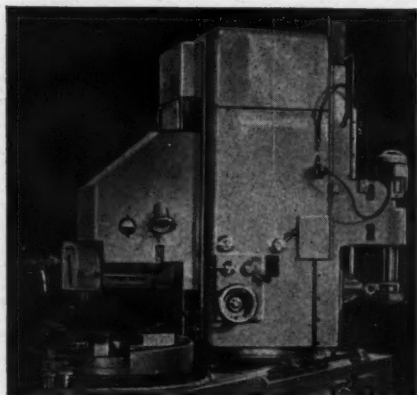


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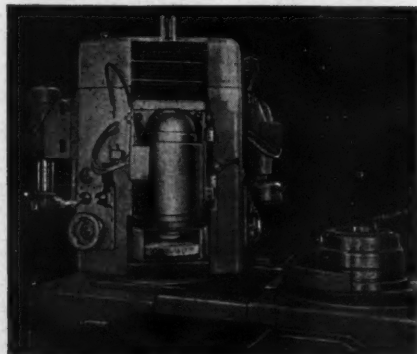
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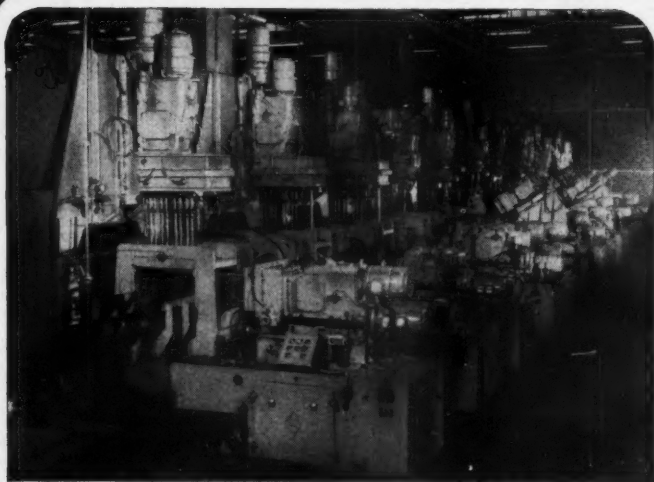
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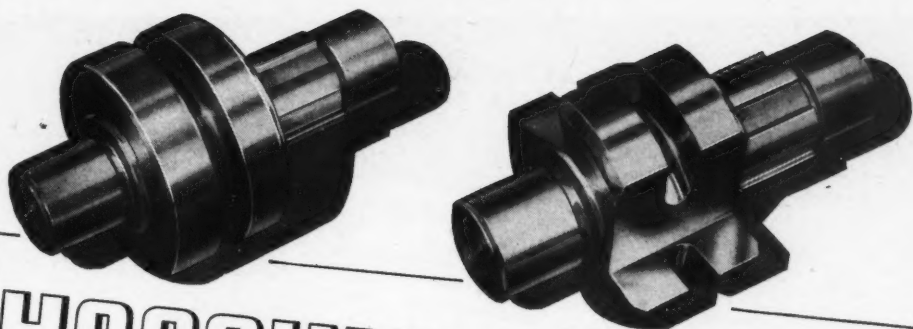


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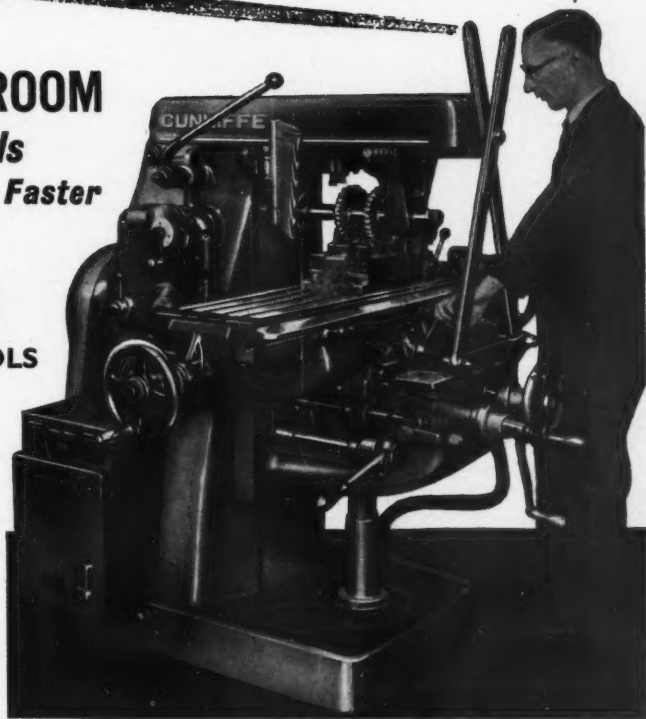
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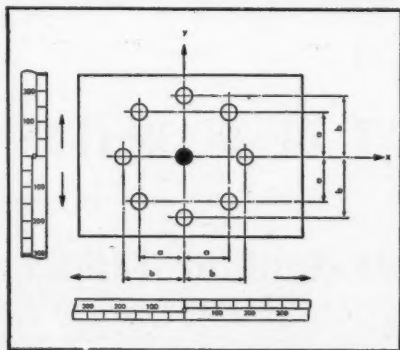
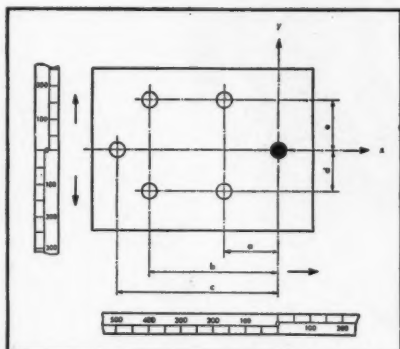
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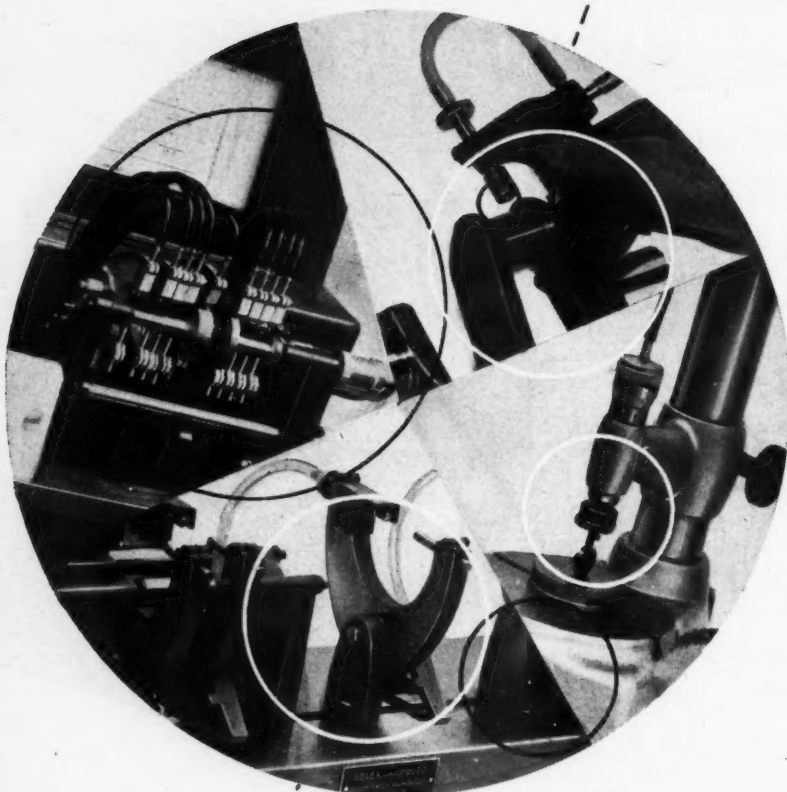
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# MACHINERY

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Vol. 98, No. 2526

April 12, 1961



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## Abstracts of Principal Articles

### Quantity Production of Poppet Valves

P. 808

Single-piece inlet and 2-piece exhaust valves for the range of passenger cars and commercial vehicles made by Vauxhall Motors, Ltd., are produced in a self-contained section of the main machine shop. Abrasive wheel and automatic bar machines are employed for cutting-off operations, the latter being so arranged that both ends of the bar are driven, to avoid the production of pips on faces to be flash-butt welded. Welding is performed on semi-automatic machines, and the heads are upset on groups of machines fitted with automatic loading units, so arranged that an electrical connection can only be made, to start the upsetting cycle, if the blank is in the correct position. Upset blanks are carried on a high-speed conveyor to the forging press on which the head is formed at a single blow in carbide dies. Hardening and tempering follow, and the valves are then cleaned in a rotary shot-blasting machine in readiness for the finishing operations. (MACHINERY, 98—12/4/61.)

### Designing Ferrous Parts for Furnace Brazing with Copper

P. 816

A comprehensive survey is given of all the various aspects and factors which must be considered when designing ferrous parts for furnace brazing, with copper as the filler material. After discussing types of furnaces, attention is directed to formulae for determining the necessary bonding areas for lapped and tubular joints, and a large section is devoted to the design and proportions of various types of joints. Means for locating parts during bonding are considered, and the final section includes many examples of components and assemblies which have been joined by brazing, including high-pressure hydraulic manifolds, high-pressure tanks, an air-conditioning impeller and an automatic torque converter, stainless-steel valve bodies, and a cylinder block for a racing car engine. (MACHINERY, 98—12/4/61.)

### Reilly Linear Displacement Transducer Measuring System

P. 826

With the Reilly measuring system, electrical signals at increasing voltages are supplied to individual rings on a reference bar, and the potential of the current

induced in a capacitance pick-up thus corresponds to the linear position of this member. The induced signal is compared withappings on toroidally-wound transformers, which are selected by means of cascaded decade switches. Any number of decades can be incorporated, and a typical arrangement provides for adjustment in increments of 0.00001 in. with a 10 in. bar. To suit particular requirements, a wide range of additional equipment can be incorporated, to provide, for example, for altering the zero position. (MACHINERY, 98—12/4/61.)

### Höfler Electronic Inspection Equipment for Gears

P. 829

A range of electronic inspection equipment has been developed by Dr. W. Höfler Maschinen-und Gerätebau, Ettlingen/Baden, Germany, for checking large diameter gears and gear cutting machines. This equipment comprises a number of measuring heads of different types which enable a gear to be checked for concentricity, tooth thickness, pitch, tooth straightness, involute shape, and surface roughness, before it is removed from the work-table of the hobbing machine. There is another attachment which is intended to be mounted on a hobbing machine or a gear shaper for checking the accuracy of the worm drive between the cutter spindle and the work-table. The various measuring heads can be connected electrically to electronic base units incorporating paper strip recorders, on which readings are marked while checking is in progress. Equipment from the Höfler range was demonstrated recently on a Liebherr gear hobbing machine at the Darnall Works, Sheffield, of Davy & United Engineering Company Limited. (MACHINERY, 98—12/4/61.)

### Protection of Electrically-driven Machine Tools

P. 837

This article discusses the various types of protective devices which are employed to safeguard electric motors against damage from such factors as failure of insulation, and faulty functioning, also to protect operators against electric shock, fire, and unexpected starting of a motor drive. Aspects discussed include heating and loading, incomplete starting, unequal voltages, over-current, earthing, fuses and cable overload, under-voltage, timing arrangements, isolation, and the use of star-delta starting equipment. (MACHINERY, 98—12/4/61.)

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## EDITORIAL

## The Importance of the Plasma Jet

Many operations now performed in metal working depend upon the ability to increase the temperature of material rapidly within a restricted area, as can be accomplished, for example, by electric resistance heating, or by the application of an electric arc or a chemical flame. Whereas these methods give excellent results for many purposes, however, their utility is restricted in some circumstances because the temperatures obtainable are not sufficiently high, or on account of the characteristics of the materials to be processed. With the object of increasing the scope of processes which involve intense local heating, therefore, considerable attention has been directed in recent years to the development of equipment whereby the properties associated with the plasma-jet can be turned to practical account. The potentialities of arc plasma heating will be at once apparent when it is pointed out that it enables temperatures up to 30,000 deg. F. or more to be obtained, whereas the upper limit with a chemical flame is of the order of 10,000 deg. F. Of equal importance, for some applications, may be the fact that with the plasma jet technique, effective protection can be afforded to materials which are sensitive to oxidation or other chemical changes when heated to high temperatures.

The term plasma indicates an ionized conducting gas such as is associated with electric-arc welding and carbon-arc lighting. In the plasma torch, a gas, which may, for instance, be argon, nitrogen, or hydrogen, is passed through a chamber in which an arc is maintained. The resulting reactions are complex, but the effects produced may be briefly explained as follows. Flow of electrons from the cathode to the anode ionizes the gas and collisions between particles travelling in opposite directions then result in heating to a very high temperature. For practical application, the equipment must be so designed that heated gas emerges from a nozzle at high velocity. At the same time it is necessary to provide for the protection of the chamber and nozzle from the intense heat. Such protection can be afforded by ensuring that the "arc column" is surrounded by an annular layer of cool gas with a steep radial temperature gradient.

With plasma equipment, the arc may be confined to the torch, and in these circumstances reliance is placed on the hot gas which issues from the nozzle. Alternatively, with the "trans-

ferred-arc" torch, there is an electrical connection to the work with the result that the arc is extended. This latter arrangement, which may be employed for cutting and welding, ensures more intensive heating.

Obviously one important field of application for the plasma technique is for cutting, particularly of those metals which are resistant in varying degrees to the action of a chemical flame. During the course of a paper read recently before the American Society of Tool and Manufacturing Engineers, Mr. R. L. Hackman reported that with the transferred-arc torches originally available it was found possible to cut aluminium plate up to 1½ in. thick. As a result of subsequent developments in torch design, aluminium plate up to 5 in. thick can now be cut successfully, and the process can also be applied to 4-in. thick plate of such metals as stainless steel, copper, and magnesium. It was also stated in the paper that several companies engaged in fabrication work had found it possible to cut ¾-in. thick aluminium plate with the plasma torch at speeds at least ten times as high as could be achieved with mechanical methods. Surfaces produced by the plasma torch, it appears, are of the same quality as those obtained when cutting mild steel with a chemical flame.

Welding has also been carried out, with promising results, with arc plasma shielded with argon. During experiments it was found that there was remarkably little variation in bead width and penetration over a range of arc lengths from ⅜ to ¾ in. In one instance, a small torch, with a ⅜-in. diameter orifice, was employed to weld 0-007-in. thick stainless steel at 25 in. per min.

The possibilities of arc plasma heating for the deposition of metals and other materials, which may be fed to the torch in the form of wire or powder, are of particular interest. On account of the high temperatures obtainable and the degree of protection afforded to the heated material, the field for spray application is greatly extended. Not only is it possible to provide protective surface layers, of many metals, refractories, and oxides, which are dense in structure and effectively bonded to the base materials, but complete components can also be obtained where production by other methods might present great difficulty. As an indication of what can be achieved, Mr. Hackman mentioned that tungsten had been deposited by

(Continued on page 858)



## Quantity Production of Poppet Valves

Methods Employed by Vauxhall Motors, Ltd., Luton

By R. E. GREEN, Associate Editor

WHEN THE DECISION WAS TAKEN, some six years ago, to make the valves required for their extensive range of passenger car and commercial vehicles, Vauxhall Motors, Ltd., Luton, had little previous experience in this field. The large numbers of vehicles produced by the company, and the need to provide for spares and replacements, necessitates the supply of quantities of valves of ten different types and sizes. Valves are now being manufactured at the rate of 54,000 per week in a highly-mechanized plant which operates on a 2-shift, five-day week basis, 32 men being normally employed per shift. In times of need, the plant has been operated on a 6-day week, and has made as many as 72,000 valves per week.

Most of the machines in the plant are fitted with automatic loading and unloading equipment, usually supplied from magazines which are charged with parts manually. Experimental and development work is at present in hand in connection with means of transferring valves from one machine to another automatically, and with hoppers and other feed units whereby the manual effort of loading can be reduced. Experience gained during the opera-

tion of the plant so far, under fairly arduous conditions of semi-continuous working, has led Vauxhall engineers to the conclusion that mechanically-operated automatic loading mechanism is the most suitable for the purpose.

Positive mechanical operation of feed mechanisms has been found to be more reliable, over long periods of use, than systems involving the use of solenoids for the control of air or hydraulic cylinders for operating such mechanisms, or of solenoids for direct actuation. Mechanical units, it is stated, have the important advantage that the cause of a stoppage can often be easily observed and put right, whereas fault-tracing in an electrical system may necessitate the services of a specialist. Most of the transfer and feed units shortly to be installed in the plant will therefore be of the direct mechanically-operated type.

Each valve requires some 17 different machining and other operations, and the total time required for the production of one valve, obtained by adding together the floor-to-floor times for the various operations, apart from heat treatment, is only 1 min. 58 sec. All inlet valves are of one-piece construc-

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tion, and are made from bar stock which is electrically upset and forged to shape, and all exhaust valves, with one exception, are of two-part welded construction, different materials being employed for the stems and the heads. The exception is the exhaust valve for the Vauxhall Victor, which is made from En. 59 alloy steel containing carbon 0.74 to 0.84, manganese 0.2 to 0.6, phosphorus 0.03 (max.), silicon 1.75 to 2.25, chromium 19 to 20.5, and nickel 1.15 to 1.65 per cent.

Drawings giving the main dimensions of typical inlet and exhaust valves are shown in Fig. 1, where the inlet valve for the Victor 4-cylinder engine is at the top. This valve has a head of  $1\frac{1}{8}$  in. and a stem of  $\frac{1}{8}$  in. diameter, approximately, and is made from steel containing carbon 0.5 to 0.55, silicon 0.05 to 0.35, and manganese 0.7 to 1 per cent, with not more than 0.06 per cent of either sulphur or phosphorus. The lower drawing in Fig. 1 shows details of the two-piece exhaust valve for the Velox and Cresta 6-cylinder engine, which has head and stem diameters of approximately 1.3 and  $\frac{1}{2}$  in., respectively.

The drawing also shows the dimensions of the blanks from which this valve is made, that for the head being of austenitic steel containing carbon 0.2, manganese 1, nickel 12, and chromium 21 per cent, to ensure adequate resistance to heat. The stem of the valve is made from 0.45 per cent carbon, low-alloy steel. Because they are of approximately the same shape, the valves are all made by basically similar methods, but attention will be drawn to certain variations made necessary by design differences or by the conditions to which the valves will be subjected in operation.

#### PRODUCTION OF BLANKS FROM BAR

Blanks from which valves are to be produced are cut from bar material which is supplied in lengths of 12 ft., and in diameters approximately 0.012 to 0.014 in. larger than those of the finished stems. This material is delivered to one end of the rectangular area in which the valve-making plant is installed, and is inspected, as necessary, for hardness on a Rockwell machine, and for diameter with a gap gauge. Material for one-piece inlet valves, and for the one-piece exhaust valve for the Victor engine, is cut into lengths which will provide sufficient material for the heading operations without excess material in the stems. For the Victor inlet valve shown in Fig. 1, which has a finished overall length of 4.672/4.707 in., the length of the blank is 8½ in.

The majority of plain blanks are cut off on an Osmond abrasive-wheel machine, which is mechanically operated, and burrs are then removed

from the ends of the blanks on a small Cincinnati grinder, also by hand. The blanks are next washed to remove grease which might cause variations in the shape of the upset, and are delivered in baskets, along a roller conveyor, to one of two groups of electric upsetting machines. Blanks for two-piece valves must have one end shaped to a cone of 150 deg. included angle, as seen in Fig. 1, and this operation is performed on the battery of Brown & Ward (Alfred Herbert, Ltd.), single-spindle automatics shown in the heading illustration.

Each of the five machines shown is fitted with a Brown & Ward automatic electrically-operated bar feed mechanism, into which a maximum of 45 lengths of bar can be loaded at one time. The bars are placed in a V-shaped chute, and the lowest bar in the chute falls into the feed tube, through a slot in the base, when the pusher arm is returned to the rear position by its endless roller chain, after the stub end of the previous bar has been ejected. Stops prevent the descent of more than one bar,

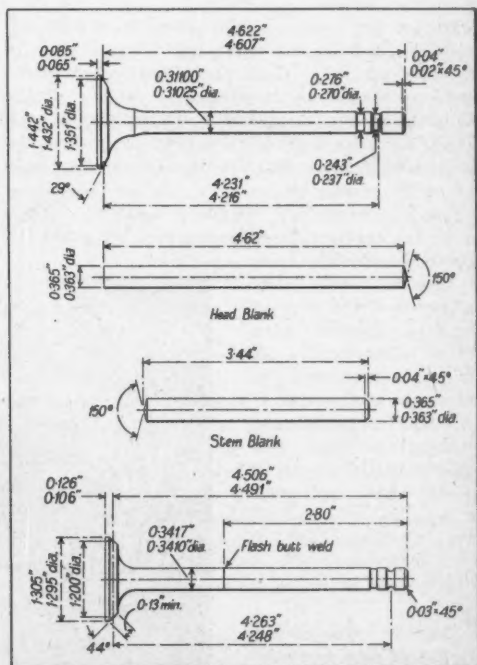


Fig. 1. Drawings showing (top) details of the one-piece inlet valve for the Vauxhall Victor, and (bottom) of the 2-piece exhaust valve for the Velox and Cresta cars, also the two lengths of bar from which it is made

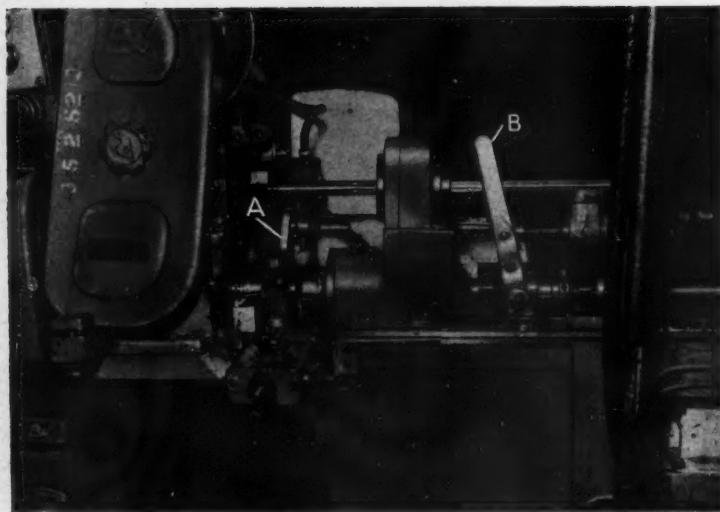


Fig. 2. On each of the Brown & Ward automatics employed for the production of blanks for 2-piece exhaust valves, an auxiliary attachment provides for holding and driving the outer end of the bar stock

and when the pusher again advances, a solenoid-operated auxiliary stop is swung down in front of the collet opening. This stop is seen at A in the close-up view of the tooling area on one of the machines, in Fig. 2, and after the collet has been closed, the stop is retracted so that the end of the bar can be machined to the required contour by a tool on the cross-slide.

This bar re-loading operation occupies some 4 sec., and after the cross-slide has been retracted, the normal machining cycle is resumed. The machine is fitted with an auxiliary spindle, seen at the right in Fig. 2, which is mounted on the ways at the end of the bed opposite the headstock. This rear spindle is driven by a splined shaft and gear-

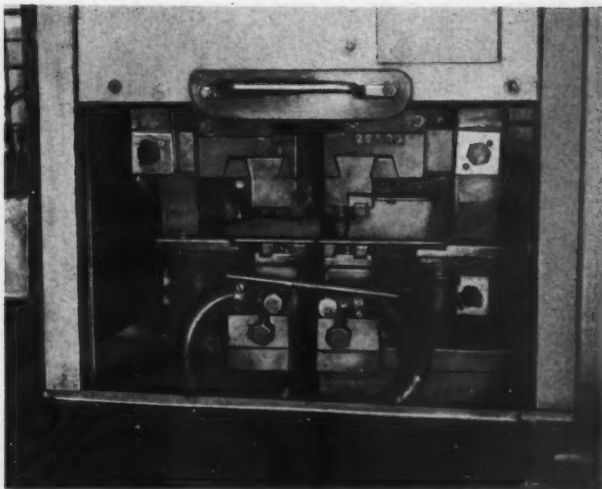
ing from the main spindle, and both run at a speed of 600 r.p.m. Within the auxiliary spindle there is a fixed back stop bar, and it is fitted with a spring collet chuck operated by the lever B, which is connected to the ram of an air cylinder. This cylinder is pivotally-mounted on a bracket at the right-hand end of the slide, and is controlled by a cam on the machine camshaft.

At the beginning of the cycle, with the rear spindle head in the forward position, the bar is fed up to the fixed stop within the rear spindle, and the collet jaws are then closed by the air cylinder. It will be noted from Fig. 1 that the blank for the valve stem, which is machined from 0.45 per cent



Fig. 3. Two British Federal flash butt welding machines are employed for welding the blanks from which 2-piece exhaust valves are made. The cycle is started by push-button

Fig. 4. Close-up view of the interior of one of the machines in Fig. 3, showing the water-cooled clamping jaws, with the bar lengths in position, and a welded assembly in the foreground. The heating current is applied for a period of 7 sec., prior to upsetting



carbon steel, has a pronounced chamfer of 45 deg. by 0.04 in. at the end remote from the 150-deg. included angle cone. This chamfer is provided to enable the operator to identify the plain carbon steel end of the welded bar when it is loaded into the electrical upsetting machine, and it is produced by a tool on the nearly vertical slide on the front face of the headstock.

When austenitic steel blanks are being produced, with a similar set-up, this tool cuts a much smaller chamfer. The tool on the front cross-slide is so shaped as to produce a flat face on one side and the required cone angle on the other, and by holding the bar at both ends in the manner described, it is possible to machine these faces without leaving any pip. After the withdrawal of the cross-slide tool, the auxiliary spindle collet chuck is opened by the air cylinder and the spindle is then retracted, the blank being ejected by the fixed stop bar. The cycle time on this machine is 25 sec.

#### FLASH-BUTT WELDING OPERATIONS ON 2-PIECE VALVE BLANKS

From the Brown & Ward machines, the lengths of bar travel in containers, along the roller tracks seen in the foreground in the heading illustration, to two British Federal, semi-automatic flash-butt welding machines, as seen in Fig. 3. These machines are of similar design and each has a pair of fixed and a pair of horizontally-sliding, water-cooled copper jaws. The upper jaw of each pair is retracted vertically for loading the blanks, power being provided by air cylinders of about 6 in. bore, operating through toggle mechanisms at the rear of the machine. During the automatic welding cycle, which occupies about 10 sec., the movable pair of jaws is slowly advanced towards the fixed pair by means of a cam at the right, which is driven through one rev. per cycle by an electric motor.

A close-up view inside the protective cabinet surrounding the working area of the machine is given

in Fig. 4, where two bars are seen in position in the open jaws, and a welded valve blank is lying in the foreground. Each bar is pushed up to a stop at the outer end during loading, and these stops prevent axial movement relative to the jaws, during the welding cycle. After loading the bars, the operator must pull down the counter-balanced sheet metal guard at the front of the machine before the cycle-start button becomes operative. The jaws are then closed and the cam-driving motor is started, to bring the cone ends together.

A heavy current is passed through the bars from a transformer in the machine base, rated at 25 kVA., and the sliding jaws are moved through a distance of about  $\frac{1}{8}$  in. during the period of 7 sec. for which the current flows. The current is then switched off, and at the same time, the jaws are moved through a further  $\frac{1}{8}$  in., by a sharp rise on the cam, to push the heated ends of the bars together for upsetting. Near-molten metal is squeezed out from between the ends of the blanks, and forms a ring at the joint. The rapid extraction of heat by the water-cooled copper jaws quickly cools the weld zone, and the jaws are opened automatically before the moving pair is retracted to the right by springs, as the revolution of the operating cam is completed.

At the end of the cycle, a catch for holding the guard closed is released, so that it can be opened for unloading the finished part. Welded bars are stress-relieved in a Wild-Barfield, 40-kW., forced circulation furnace, installed at the rear of the upsetting machines. The blanks are packed in baskets and heated to a temperature of 600 deg. C., which is maintained for 1 hour. The weld on



Fig. 5. Electric upsetting of the valve blanks is performed on British Federal machines, which deliver the red hot blanks to a high-speed conveyor leading to the 160-ton H.M.E. friction screw press in the background

each bar is then visually inspected and the flash is trimmed off at a simple set-up on a Herbert No. 25 lathe, with a flat form tool on the cross-slide, which is plunge-fed. Subsequently, the bars are passed through two Churchill No. 2 centreless grinding machines, arranged in tandem, each of which removes 0.005 in. from the diameter, to bring them to 0.353/0.355 in., for the valve shown in Fig. 1.

#### UPSETTING AND FORGING THE HEADS

The next operation, on both inlet and exhaust valves, is the upsetting of the head, followed by forging to the required shape without re-heating, and is carried out on one of three groups of machines. One of these groups comprises three, and the others, two, British Federal electrical upsetting machines, with a Hordern Mason & Edwards, 160-ton capacity, friction screw press, and the first-mentioned group is shown in the general view in Fig. 5. Here, one of the Churchill centreless grinders is seen at the extreme left. The upsetting machines are installed on a concrete plinth, to bring them to a height convenient for feeding the upset blanks to the forging press at the far end.

A close-up view of one of the upsetting machines is given in Fig. 6, and it will be seen that it is of weld-fabricated steel construction, and has a large-diameter air cylinder at the right-hand end. This

cylinder provides power for the upsetting operation, and it is connected to an adjustable sliding ram which makes contact with the stem end of the blank. At the left-hand end of the vertical front face of the machine there is a retracting-head unit, which incorporates a water-cooled electrode with an anvil face of Copelmet hard copper alloy. This electrode is clamped to a slide which moves horizontally in square-section ways, and the slide is connected to a piston in a large hydraulic dash-pot C.

The dash-pot is connected, through an adjustable control valve, to an oil container on top of the machine, the speed of movement of

the anvil to the left being controlled by the valve setting. After upsetting has been completed, the anvil is returned to the right by a small, single-acting air cylinder immediately beneath the dash-pot C, the ram of this cylinder being connected to the anvil slide. The speed of retraction of the anvil governs the shape and size of the upset formed on the valve blank, and a typical upset blank is shown in Fig. 7, together with a two-piece welded bar, and forged and completed valves. The completed valve shown is for a commercial vehicle engine.

The upsetting machine is fitted with automatic loading equipment, which incorporates a V-shaped magazine chute into which the blanks are loaded with the chamfered ends to the right. The V-portion of the chute leads the blanks down to a parallel-sided portion, the walls of which are so spaced as to allow the passage of only a single row of blanks. At the bottom of the magazine, the blanks are supported by a double plate arrangement, the lower plate, which is the longer, carrying the air-operated feed mechanism. The upper plate has a longitudinal slot, of dimensions just large enough to permit passage of the blanks, and it is connected to two flat bars which extend towards the camera in Fig. 6.

Brackets on these bars provide for connection to the lower ends of two vertical levers D, which are pinned to a horizontal shaft, held in bored holes in

the chute structure. To the left-hand end of this shaft is clamped a lever, through which movement is transmitted from the air cylinder *E*, pivotally-mounted at the side of the chute. When this cylinder is actuated, the upper plate of the magazine is moved horizontally, and one extremity of its movement brings the slot to a position directly beneath the magazine opening so that the lowest blank in the stack descends.

The plate is then moved, carrying the blank forward, until the slot passes the edge of the lower plate, and the blank is allowed to fall on to two support bars. On these bars, the blank is supported in a horizontal position with its axis aligned with those of the upsetting and anvil rams, between a fixed and a moving clamping jaw. Each jaw takes the form of a copper slug, of about 2 in.

diameter by 1 in. thick, and the fixed jaw, which is held in a clamp on the machine face, is completely circular. The moving jaw has a number of V-shaped grooves, parallel with its axis, which serve to locate the components, and is also clamped in position. When the jaws become worn, they can readily be turned to fresh positions.

Locations, in which the moving jaw is clamped, are provided on the end of the ram of the horizontal air cylinder *F*, secured to the under-side of the magazine, and this ram also carries one of the support bars for the blank. The other support bar is fixed to an extension *G*, of the magazine slide, and it carries an electrical contact near the inner end. This contact is insulated from the remainder of the machine, and when the valve blank is correctly aligned, a small current can flow through it. This current is employed to operate a relay which starts the automatic upsetting cycle of the machine, and with this

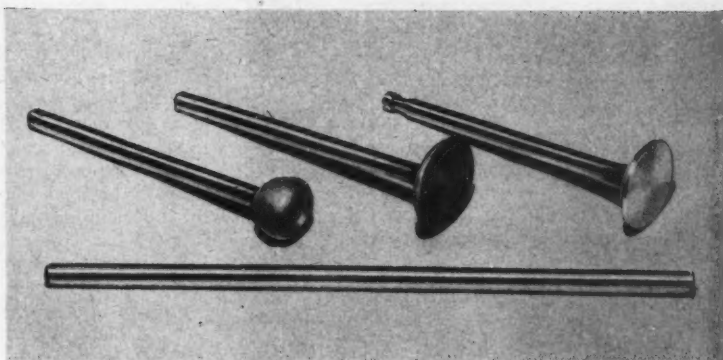


Fig. 7. Welded and upset blanks, a forging, and a completely machined 2-piece exhaust valve as produced by Vauxhall Motors, Ltd., in a series of 17 operations with a total cycle time of slightly less than 2 min., apart from heat treatment

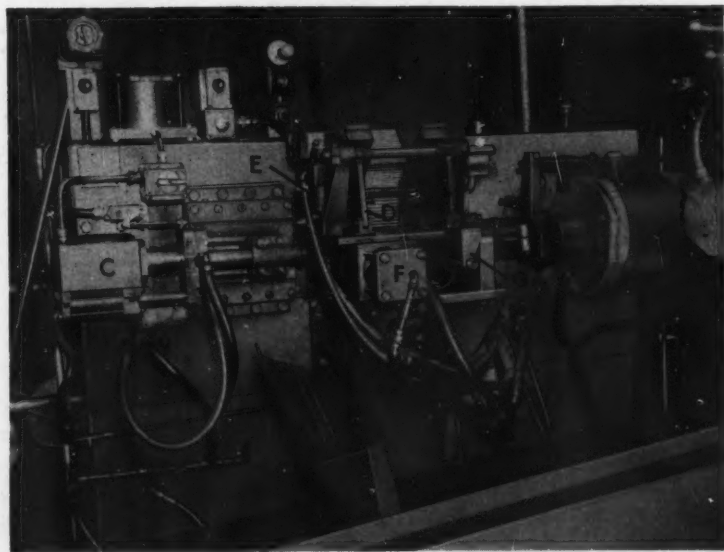
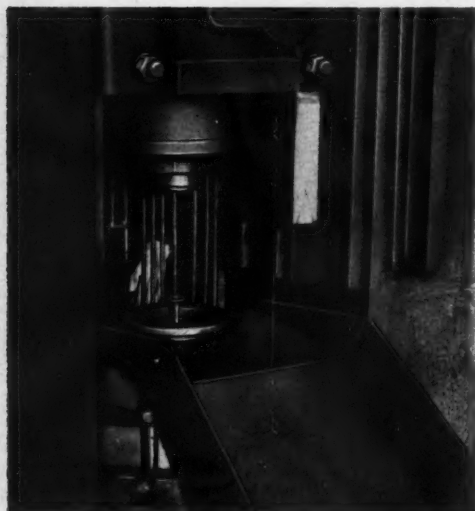


Fig. 6. A view showing details of the automatic loading equipment fitted to the British Federal electric upsetting machines. An electrical circuit must be completed through the blank to initiate the automatic cycle of the machine



**Fig. 8.** In this view of the tungsten carbide tools employed on the 160-ton, H.M.E., friction screw press, the forged valve is seen partially ejected. An air blast from a nozzle at the far side blows the valves down the chute into a box

arrangement, the cycle can only be initiated when a blank is in the correct position.

At the start of the loading cycle, the magazine slide is in the withdrawn position, and when the air supply to the cylinder *E* is reversed by a limit switch actuated at the end of the previous cycle, the slide moves forward. The next blank is deposited on the support arms, and if it takes up the correct position, the upsetting cycle starts. The jaws are then closed on the blank and the large cylinder at the right is energized, to push the left-hand end of the blank into contact with the anvil on the retracting head at the left. A heavy heating current now flows between the anvil and the clamping jaws, the pressure of which is only sufficient to ensure good conduction of the current to the bar without burning.

This current rapidly brings the length of about 1½ in. of bar between the jaws and the anvil to a red heat, and the bar then begins to deform under the force applied by the large air cylinder. At the same time, the retracting head moves the anvil to the left at a controlled speed, allowing the metal to flow outwards and gather up into a head of the shape seen at the left in Fig. 7. This head takes up about 3½ in. of the bar and is formed in a period of about 15 sec., during which both the upsetting

ram and the retracting head are being moved continuously.

On reaching the end of its stroke, the upsetting ram operates a micro-switch with the result that the air flow to the large cylinder is reversed, and the jaws are opened. The magazine slide having in the meanwhile been returned to its withdrawn position, the support rod on the extension *G* is no longer beneath the valve blank, so that when it is released by the clamping jaws, it falls, turning about the support bar connected to the moving jaw, and slides down the chute *H*. This chute leads to an enclosed, steel mesh conveyor belt, which runs continuously at a speed of about 300 ft. per min., and the blank is carried rapidly to the far end of the belt, to the right.

At the end of the belt the blanks are guided towards two parallel steel bars, and travel down to a position at which one of the bars is bent at right angles. Here, each blank is arrested and suspended by its head in a position from which it may be conveniently picked up in a pair of tongs by the operator of the H.M.E. friction screw press, and placed in the die. The time from leaving the upsetting machine until the blank reaches the end of the conveyor is not more than 5 sec., so that the head is still a bright red when placed in the die.

Dies employed for shaping the upset head of the valve to the required form are made of tungsten carbide, and a forged valve, partially ejected, is seen in the view in Fig. 8, from the rear of the press. As may be seen from Fig. 7, where the example at the centre is in the condition in which it left the die, the head of the valve is shaped with smooth surfaces of accurate form. The dies have a life of some 40,000 to 50,000 pieces when new, and after this number of operations has been completed, they can be re-polished to provide for a further, similar, period of service. A check is kept on the number of valves produced by means of an automatic counter which is operated by the press ram, so that the condition of the die can be inspected at appropriate intervals.

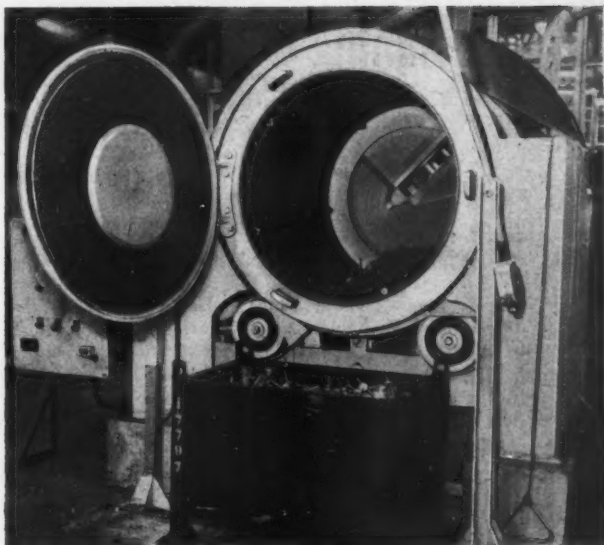
#### HEAT TREATMENT

The sequence of heat treatment operations through which the valves now pass is so arranged as to produce the most suitable internal structure to withstand the conditions encountered in service. In general, valves for car engines are tempered at a higher temperature than those for commercial vehicles for which greater hardness is required to resist wear. Heat treatment is performed in two series of furnaces, and the entrance to one of the furnaces is seen in Fig. 9. Made by the Incandescent Heat Co., Ltd., this furnace has a through-

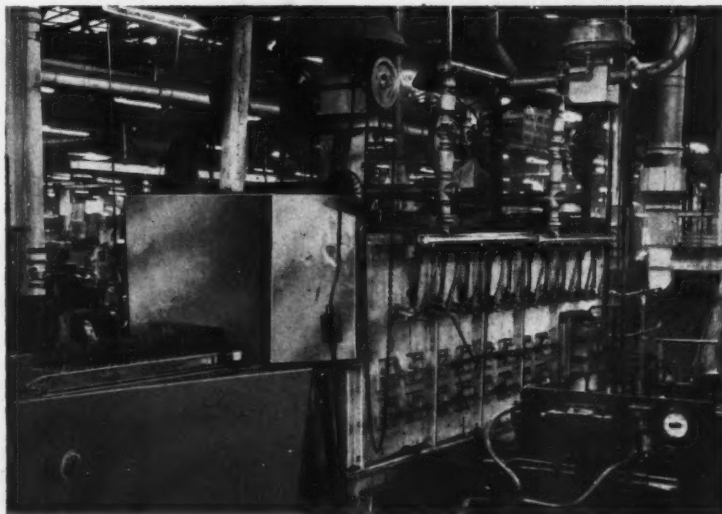
put of 1,065 Victor valves per hour, and is gas heated. Valves are loaded, head downwards, in rows on the heat-resisting steel wire mesh conveyor band which carries them through the furnace at the rate of about 2½ in. per min.

During their passage through the furnace, valves are normally heated to 850 deg. C., but for the stainless steel one-piece Victor exhaust valve the temperature is 1,000 deg. C. The hardening furnace has an overall length of 15 ft., through which the valves pass in approximately 1 hour, and they are discharged from the heated zone into an oil tank beneath, when they reach the return roller for the conveyor band. From this tank, the valves are lifted by a drag-out conveyor and fed into a Curran washing machine in which oil is removed. Next, the valves pass through a second, tempering furnace, arranged in line with the previous units, usually at a speed of about 1½ in. per min.

The tempering furnace has an overall length of about 30 ft. which is traversed in approximately 3½ hours,



**Fig. 10.** After heat treatment, all valves are passed through this Spencer & Halstead Centriblast shot blasting plant in order to remove scale. This equipment can treat loads ranging up to 1,350 valves in a cycle time of 8 min.



**Fig. 9.** Heat treatment, for hardening and tempering, is performed on a continuous basis in Incandescent gas-heated furnaces and other equipment, arranged in line. The entrance to the hardening furnace is shown here and it has capacity for 1,065 Victor valves per hour

and the majority of inlet valves are tempered at 550 deg. C. Most 2-piece exhaust valves are tempered at temperatures between 300 and 430 deg. C., depending on the application. The Victor exhaust valve is tempered twice, at 870 and 700 deg. C., to obtain the desired physical qualities. Removal of scale is subsequently carried out in the Spencer & Halstead Centriblast shot blasting plant, Fig. 10, installed near the outlets of the heat treatment lines, which accommodates up to 1,350 valves, a full load being treated in 8 min.

Further operations on valves will be described in subsequent articles.

# Designing Ferrous Parts for Furnace Brazing with Copper

By E. C. BUCKINGHAM\*

THIS ARTICLE IS CONCERNED primarily with the design of ferrous parts for furnace brazing when copper is to be used as the filler metal. Since, basically, the same considerations apply, the brazing of high-alloy steels with special alloy fillers for high-temperature applications is also discussed.

A typical installation for copper brazing takes the form of a roller-hearth conveyor type electric furnace arranged for automatic charging, in which a controlled, slightly reducing, atmosphere is employed to promote the flow of the filler metal and prevent oxidation of the parts that are being processed. The parts are slowly heated, bonded, and then cooled all within the protective gas envelope, to prevent discoloration and to minimize distortion due to thermal stress. Assemblies brazed in this manner remain clean and bright, and do not require subsequent pickling or other cleaning.

A furnace atmosphere commonly employed in the U.S.A. is obtained by the exothermic burning of natural gas and compressed air over a nickel-impregnated catalyst brick. The products of combustion are thoroughly dried before being introduced into the furnace.

A designer must have a clear understanding of a process in order to take full advantage of the possibilities which it offers. In the case of copper brazing, these advantages are: high-strength, pressure-tight joints, economy through the use of inexpensive steels, the complete or partial elimination of machining operations, and good appearance of the finished parts.

The cost of even the most intricate assemblies can be greatly decreased by breaking them down into simpler components. Machining operations can be reduced by using stock parts such as standard gears, bolts, washers, and tubing. Stampings can often be employed in place of castings or forged parts, and screw machine parts can be substituted in some instances for more expensive components.

Theoretically, there is no limit to the number of joints in an assembly which may be brazed during one passage through a furnace. In practice,

moreover, the greater the number of bonded joints in an assembly, the lower the cost per joint.

Copper-brazed parts may be heat-treated, annealed, carburized, or nitrided after they have been bonded. The temperatures involved in these processes are all below the melting point of a copper-bonded joint. Finish machining prior to bonding is usually practicable, since parts do not require to be pickled or cleaned after they have been brazed. Machining to very close tolerances should be avoided, however, as decarburization, distortion, or misalignment may occur and cause complications.

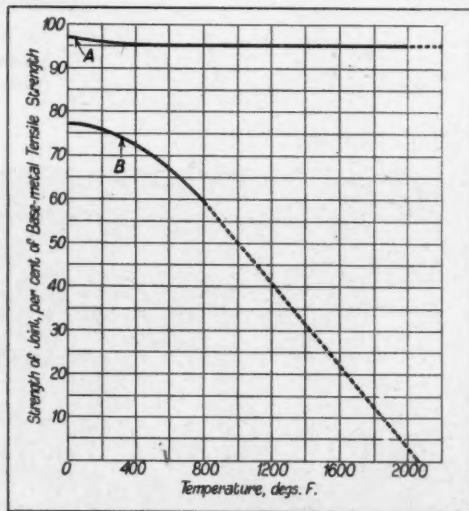


Fig. 1. Graph showing relation between brazed-joint strength (expressed as a percentage of base-metal tensile strength) and temperature for nickel-silicon-boron alloy (curve A) and copper (curve B) brazing fillers. The dotted portions of the curves indicate the temperatures at which degradation of the brazed joint can occur through progressive oxidation. If the curves are to be used directly, the shear strengths of the joints obtained must be compared with the shear strengths and not with the tensile strengths of the base metals.

\*Superweld Corporation, North Hollywood, Calif., U.S.A.

Although it would be very convenient for the designer to have a fixed value for copper-brazed joints, the properties of these joints cannot be simply stated. It has been established that the strength of a brazed joint is directly proportional to the strength of the base metal with which the joint is made.

The chart that is shown in Fig. 1 indicates joint strengths as percentages of the tensile strength which would exist if the bonded areas were not joints but solid base metal. Two curves are shown for joints that have been furnace-brazed with different filler metals. These curves were plotted on the basis of tests made on many units from different sources, and have been checked in practice.

When using the chart in Fig. 1 to determine the strength of a joint, the shear strength may be taken as one-half the ultimate tensile strength shown. Thus, a joint for which copper is employed as the filler metal, when stressed in shear, will exhibit, at room temperature, one-half of 77 per cent of the U.T.S. of the parent metal.

#### DETERMINING THE NECESSARY BONDING AREA

Whereas a lap with a length which is three times the thickness of the thinnest member will hardly, if ever, fail under load, the following formulae may be used for accurate determination of joint overlap (Fig. 2):

$$X = YTW/L$$

where

$X$  = depth of shear area required, in.

$Y$  = numerical safety factor

$T$  = ultimate tensile strength of thinnest or weakest member, lb. per sq. in.

$W$  = wall thickness of thinnest or weakest member, in.

$L$  = shear strength of joint, lb. per sq. in.

but since

$$L = TQ/2$$

where

$Q$  = the percentage factor from Fig. 1

$$X = 2YW/Q$$

Example: A copper-brazed part is to be used at room temperature in the as-bonded condition. It is made from C 1015 steel with an ultimate tensile strength of 60,000 lb. per sq. in. The safety factor is to be 1½, and the wall thickness of the thinnest member is ⅜ in. Find the depth of shear area  $X$  required.

In this case, the value of  $Q$  from Fig. 1 is 77 per cent. Therefore, using equation (1)

$$X = 2YW/Q = (2 \times 1\frac{1}{2} \times \frac{3}{8}) / 0.77 = 0.487 \text{ in.}$$

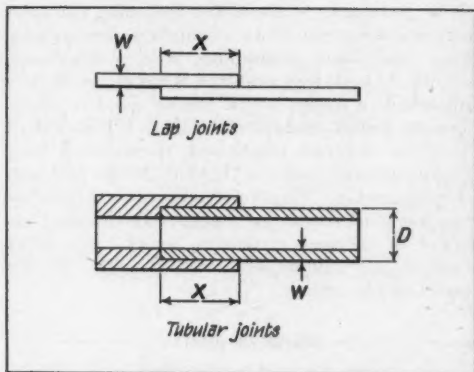


Fig. 2. Diagrams showing how the symbols in the formulae relate to lap and tubular joints

For tubular joints (Fig. 2) the following equation will give the necessary bonding area:

$$X = YTW(D - W)/LD \\ = 2YW(D - W)/QD$$

where

$D$  = diameter of shear area, in.

Example: A part which is to be heat-treated to Rockwell C 28 to 30 after it has been copper brazed is to be stressed at a maximum temperature of 300 deg. F. in service. The weakest member has an ultimate tensile strength of 134,000 lb. per sq. in. and a wall thickness of 0.062 in. The diameter of the shear area is 1 in., and a safety factor of 2 is specified. Find the depth of shear area required.

At 300 deg. F.,  $Q$  for copper, from Fig. 1, is 74 per cent. Then by substituting the required values in equation (2):

$$X = 2YW(D - W)/QD \\ = [2 \times 2 \times 0.062(1 - 0.062)] / 0.74 \\ = 0.31 \text{ in.}$$

The maximum safe service temperature for continuous operation of parts brazed with copper is taken to be 800 deg. F. Above that temperature, oxidation may act to decrease the effective area. Copper-brazed parts are not adversely affected by operating temperatures as low as -100 deg. F., or by temperatures of 1,800 deg. F. for short periods during heat-treatment. Any ferrous metal may be copper-brazed. However, a good designer will always first consider the use of plain, low-carbon steel. Carburizing or work hardening after bonding may be possible when annealed SAE 1010 steel does not have sufficient stiffness or surface hardness for a given application.

It is preferable to avoid the following elements when selecting material: chromium, manganese, silicon, vanadium, aluminium, zinc, sulphur and titanium. At high temperatures, these elements may form selective oxides which inhibit good bonding. If parent metals contain more than 1 per cent of any of the elements mentioned, special care must be taken in connection with joint design and surface preparation. Caution is also necessary when designing joints involving metals with different coefficient of thermal expansion, which may affect clearance, and consequently the strengths of the completed assemblies.

### DESIGN OF JOINTS

If possible, joints should be so designed that they will be stressed in shear or compression, as seen in Fig. 3, and lap joints are recommended wherever practical. As previously mentioned, a lap with a length which is three times the thickness of the thinnest member will practically never fail. Butt joints, such as T-joints and corner joints, should be

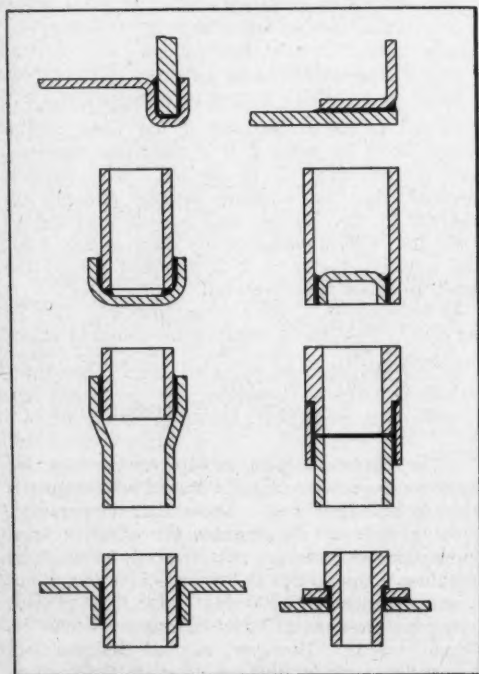


Fig. 3. Wherever possible, brazed joints should be stressed in either shear or compression. A number of acceptable designs is shown here

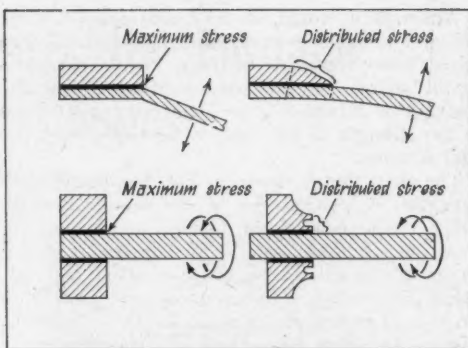


Fig. 4. Tearing of a thin member due to flexure at the edge of a joint, as at the upper left, can be avoided by the design seen at the upper right. Where torque reversals are involved, the design at the lower right will ensure better distribution of the stresses during service

used only if metal-to-metal contact can be maintained throughout the bonding cycle.

When a joint involves a thick and a thin member, flexing of the thin member may set up a tearing action at the edge of the joint. This condition may be avoided by slight changes in design, as shown in Fig. 4. Where there is an approximately equal mass on each side of the joint, possible difficulties due to unequal expansion of light and heavy members during the brazing cycle are avoided as indicated in Fig. 5.

Large mating radii are undesirable, as possible voids in such joints cannot be detected by visual inspection. Moreover, positioning of parts by double shoulders should not be attempted. One positive shoulder should be used for location and a radius matched with a chamfer as shown in Fig. 6.

Closed assemblies such as tanks or pressure vessels should be provided with vent holes. Unless this precaution is taken, expansion of gases in the interior may force the components apart during heating. Dead-end holes may act as small pressure vessels, and should be vented as shown in Fig. 7. Clearance, where parts fit into one another, has an important effect on the ultimate joint strength, as seen in Fig. 8. If parts are a heavy drive fit, due to normal variation in mass-production, there will almost always be surface prominences which will cause high local pressures during bonding and produce actual grain growth across the boundary. This condition can be an effective barrier to the flow of filler metal, and may result in a partially filled joint of reduced strength value.

**THE EFFECTS OF FILLETS**

Inspectors like to see fillets, and, in general, the presence of a neat, concave fillet is desirable. A brazed joint is really a small casting, and therefore can sometimes benefit from being able to draw upon the reservoir of metal in the fillet, to compensate for shrinkage during solidification.

With some types of joints, a fillet can provide additional strength to withstand certain stresses, as indicated in Fig. 9. Izod impact tests were made, in one instance, on a T-joint of the type shown in Fig. 10. Without a fillet, failure occurred at about 11 ft./lb. With a larger fillet than normal, this figure was raised to more than 100 ft./lb.

A good working rule for deciding whether to provide for a fillet in a joint design is illustrated in Fig. 11. Whenever the dimension A approaches 30 per cent of the dimension X, a fillet can be included to advantage. Thus, the fillet can add

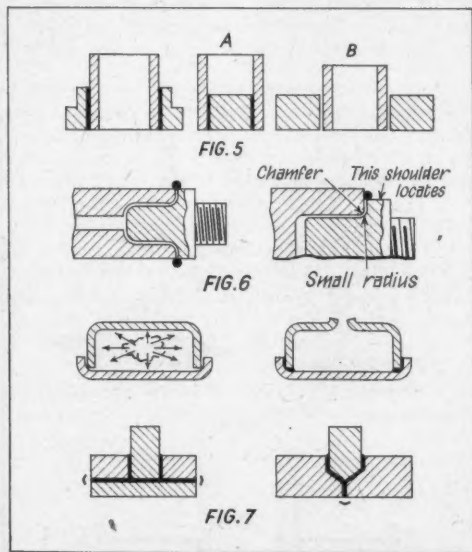


Fig. 5. Approximately equal mass on each side of a joint is desirable as on the left. Unequal expansion may cause voids in the joint at A and prevent filler flow with the design at B

Fig. 6. Parts to be joined should not have large mating radii or be positioned by double shoulders as on the left. Location should be taken from a single shoulder and a small radius should be provided opposite to a chamfer

Fig. 7. Holes should be provided to vent closed assemblies and dead-end recesses, which may act as pressure vessels during the brazing process

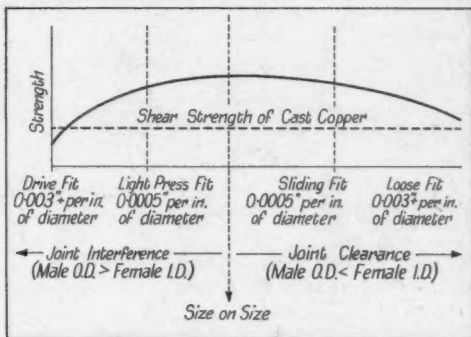


Fig. 8. Graph showing how the strength of a copper-brazed joint is affected by the type of fit

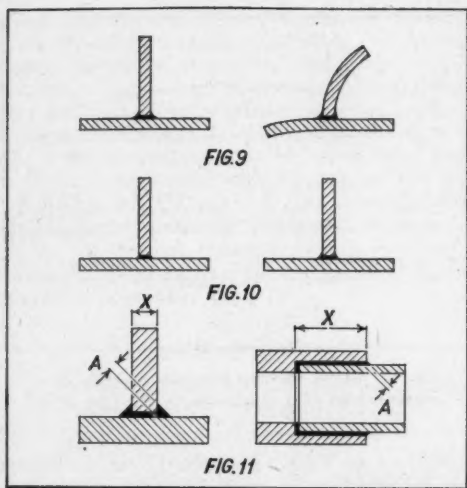
strength to the T-joint, but with the tubular joint it will be relatively so small as to have no value. However, due to the limitations on practical fillet size, fillets are of importance only when the dimension X is less than  $\frac{1}{8}$  in.

Knurling, surface roughness, rust, mill scale, or threads which interrupt or touch joint surfaces provide capillary passages for the flow of the filler metal and prevent the formation of fillets. Consequently, when fillets are required, it is necessary to polish, machine, or grind the surface, or control the direction of tool marks, to ensure that capillary flow away from the joint area will not occur, as indicated in Fig. 12. When fillets are not desired, parts should be blasted before assembly with 80-mesh steel grit. The copper will then spread, leaving practically no fillet, as seen in Fig. 13.

A joint with 0.0005-in. clearance, which had a normal ultimate shear strength of 23,000 lb. per sq. in. (77 per cent of the shear strength of the base metal at room temperature, Fig. 1), remained unbroken after 10,000,000 reversals of a torque load of 10,600 lb. per sq. in. On another sample, an increase in torque loading to 11,000 lb. per sq. in. brought about metal failure after 10,000,000 reversals. Whenever samples with light interference fits have been tested, the mild-steel base metal—not the joint—has failed if loading passed this point. In practice, fillets would remain to reduce maximum stresses in the joints, whereas they were removed for the test mentioned above.

**LOCATING PARTS FOR BONDING**

Metal-to-metal contact throughout the joint area must be maintained to ensure that sufficient alloying can occur. Alloying takes place when (1) either the parent metal or any of its constituents dis-



**Fig. 9.** Diagrams showing how a fillet will assist in distributing bending stress

**Fig. 10.** Under Izod impact tests the part on the left, without a fillet, failed at 11 ft.-lb. The part at the right with a generous fillet failed at more than 100 ft.-lb.

**Fig. 11.** A fillet will add strength to a joint only if the dimension *A* approaches 30 per cent of the dimension *X*. The T-joint at the left will be strengthened by a fillet, but not the tubular joint at the right

solves in the molten filler material, or (2) when some of the molten filler material diffuses into the solid surfaces of the parent metal. This diffusion can occur when the equilibrium systems of the paired solid and liquid metals show definite evidence of intersolubility, either as solid-solution phases or as intermetallic compounds. Such intersolubility can cause rapid increases in the viscosity of the filler metal during its flow. Hence, although a light press fit is usually recommended, it may sometimes be necessary to provide appreciable joint clearance, when certain alloy combinations are involved.

To prevent movement of parts during the bonding cycle, self-locating features should be provided. Such features permit rapid and inexpensive assembly and hold the work to the required tolerance. A shoulder is one of the best and simplest means of location, but many others are used, some of which are shown in Fig. 14.

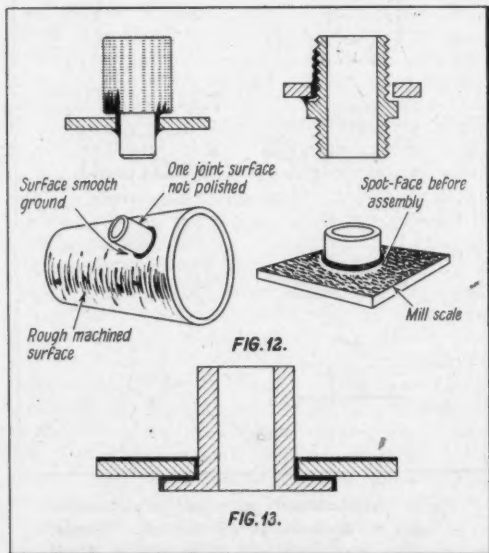
A light press fit is often provided in order to achieve maximum joint strength where the joint area is restricted for reasons of weight. Since

manufacturing tolerances should provide from 0-00025- to 0-001-in. interference per inch of joint diameter in order to gain this joint-strength advantage, the cost of close tolerances must be compared with that of providing greater joint area with wider tolerances. Whenever joint length exceeds joint diameter, it is considered that the additional cost involved in providing a light press fit is unnecessary. Sufficient surface roughness, or knurling, on the male component will prevent parts from slipping.

When press fits are used, the outer component should not be heated, as the resulting scale may result in unsound joints. A light press fit is all that is required. Where long tubular sections are involved, and alignment is essential, assembly may be facilitated by cooling the inner member in dry ice.

#### FLOW OF FILLER MATERIAL IS IMPORTANT

If the following suggestions are adopted, joints can be designed to take advantage of both gravity and capillary flow of the filler metal. If possible, the assembly should be arranged so that the filler



**Fig. 12.** Rough-machined surfaces, rust, and mill scale will prevent formation of fillets. If a fillet is required, smooth surfaces should be provided or the direction of tool marks should be such as to prevent capillary flow away from joint, as indicated in the two lower views

**Fig. 13.** Blasting of parts with steel grit prior to assembly will prevent the formation of fillets

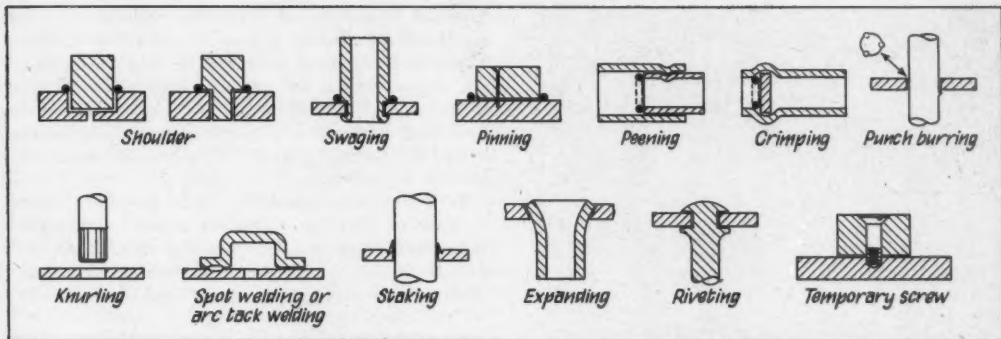


Fig. 14. Various methods of preventing movement of parts during furnace brazing. Where a shoulder can be provided, the required result is obtained simply and effectively

material is above the joint during the bonding cycle. A locating surface should be provided for the filler metal, in the form of an external or internal shoulder, groove, chamfer, or similar feature, as indicated in Fig. 15. For lap joints, the parts should be so designed that the maximum length of flow of the filler metal is less than 1½ in. from the point of entry. If flow over a greater distance is necessary, wells should be provided inside the joint to hold rings of filler metal.

Whenever possible, provision should be made for inspection at both ends of a joint. If this objective cannot be achieved, an attempt should be made to provide for inspection at the end opposite the point of entry of the filler metal. Parts should not be too smooth. For the best results, the surface roughness of joint areas should be between 100 and 250 micro-inches on the inner member, and not less than 40 micro-inches on the outer member.

If centreless grinding is carried out on the male member to maintain close tolerance, the male bonding surface should be blasted with steel grit or liquid-honed prior to assembly. Any hydrocarbons left on the joint surfaces of an assembly—as a result of handling, inadequate degreasing, or carelessness—may prevent correct bonding and result in a marked reduction of joint strength.

Visual inspection appears to be the most satisfactory, despite the increasing use of newer methods. A good inspector, familiar with copper brazing and the functional requirements of the parts, will usually detect any unit of doubtful quality. If visual examination cannot meet a particular set of special requirements, and if the additional expense is warranted, inspection can be carried out by X-ray, proof testing, chemical corrosion testing, metallographic examination, or ultrasonic testing, depending on the workpiece.

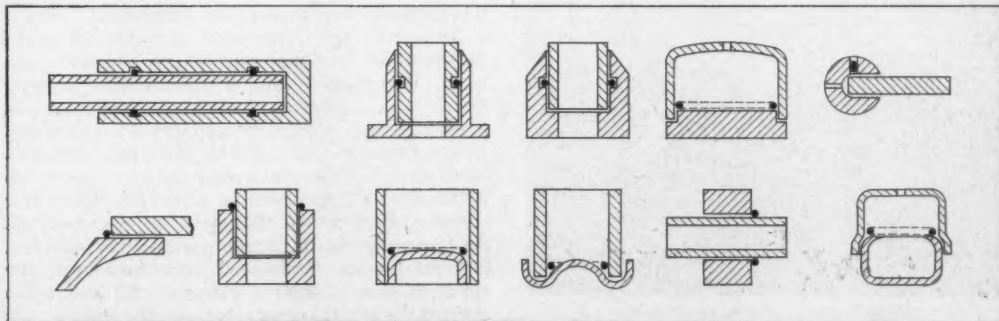
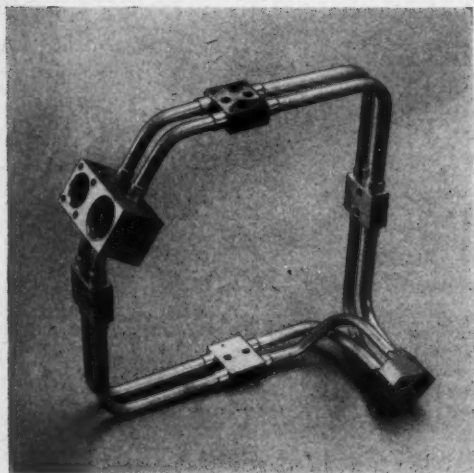


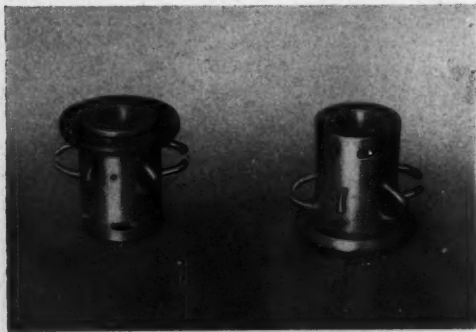
Fig. 15. The diagrams show various ways of locating the filler metal for brazing. It is preferable to place the filler material above the joint, if possible



**Fig. 16.** This copper brazed hydraulic manifold is being produced in quantity for a missile application. Tolerances are close and difficult to maintain because the thin-walled stainless-steel tubes are joined to parts of much greater mass

#### **APPLICATIONS OF FURNACE BRAZING WITH COPPER AND HIGH-TEMPERATURE FILLER ALLOYS**

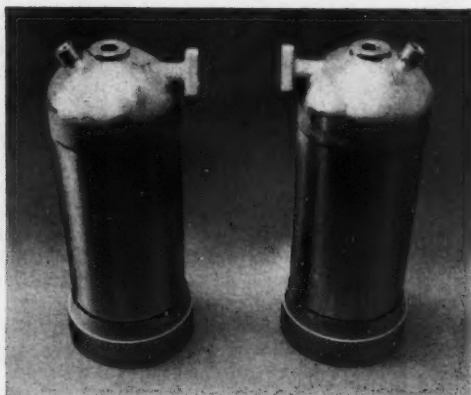
The brazing of certain close-tolerance assemblies presents various problems, but limits of  $\pm 0.010$  in. have frequently been maintained under experimental conditions. The assembly shown in Fig. 16 is a hydraulic manifold made by the



**Fig. 17.** Sixteen separate components are furnace-brazed with copper to form each of these assemblies. Interference fits are used for maximum strength

Nortronics Division of Northrup Aircraft Co. for the Hawk missile. It is a good example of a close-tolerance component required in large quantities. The tubes, which are of AISI type 321 stainless steel, have thin walls and are copper-brazed to machined connectors of much larger mass. Owing to this difference in mass, tolerances are extremely difficult to maintain.

To produce the assemblies, fixtures are employed to ensure that the tolerances are maintained throughout brazing. The brazing alloy is applied after the manifold has been assembled in the fixture, and all 44 joints to be brazed (and 13 con-



**Fig. 18.** High-pressure tanks made from castings and tubing joined by furnace brazing in a hydrogen atmosphere, using a copper-paste filler. The parts are tack-welded in position in preparation for the brazing operation

nections) are checked for correct location before the assembly is placed in the furnace.

If the completed assembly is within tolerance, the fixture is enclosed in a retort, which is then sealed and purged with nitrogen. After purging has been completed, a transportable furnace is positioned over the parts, and dry hydrogen gas, with a dew point of  $-100$  deg. F., is admitted to the retort. The temperature is raised to  $2,050$  deg. F., and held at this value for a few minutes after which the heat is switched off. Subsequently, the hydrogen gas flow is continued, and the furnace is removed from the base. The retort is then cooled to  $300$  deg. F., and again purged with nitrogen, before the parts are removed.

At this point, all brazed joints are inspected and checked for accuracy. The side connections

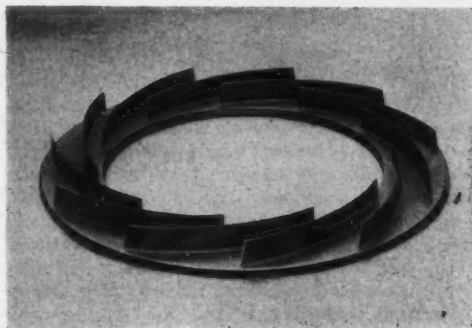
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must be located within  $\pm 0.010$  in., and the inlet connection within  $\pm 0.030$  in. Finally, the assembly is subjected to a hydraulic test, at a pressure exceeding 4,000 lb. per sq. in.

An alloy-steel assembly made up of 16 separate components which are copper-brazed together is shown in Fig. 17. Known as a carrier assembly, it was specially designed for brazing, and consists of two machined sleeves, a casting, a forged ring, and twelve exterior tubes. Assembly is carried out after all parts have been thoroughly inspected and cleaned, and the brazing alloy is applied as the parts are being placed in position. For maximum strength, the components are all made with interference fits. The exterior tubes are checked for position prior to bonding, which

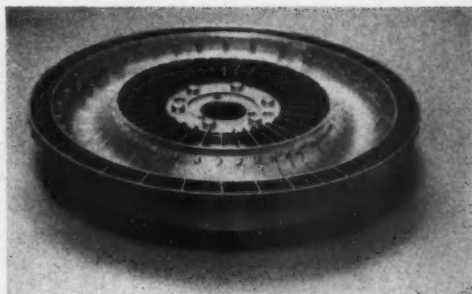


**Fig. 19.** This air-conditioner impeller for use in aircraft is furnace-brazed. A fixture applies a load on each vane to maintain metal-to-metal joint contact during bonding

is performed in a furnace of the continuously operating type, under a protective atmosphere.

Final inspection involves visual checking for 100 per cent alloy penetration and flow. Since the assembly has many internal passages, the copper penetration must be limited to the joint areas.

High-pressure tanks for missiles are shown in Fig. 18. The top and bottom members are of cast alloy steel, and are connected by lengths of AISI 4130 steel tubing. The castings are assembled to the tubing and Heliarc tacked-welded to ensure accurate positioning. After a copper-paste filler has been applied to the exterior joint areas and allowed to dry, the parts are brazed in a hydrogen atmosphere, which prevents any decarburization during the process. Inspection again involves visual examination for 100 per cent penetration of the filler. Since the filler metal in the upper



**Fig. 20.** Automotive torque converter that has been repaired by brazing in an exothermic furnace atmosphere. Copper-paste filler was used

joint must penetrate upwards for approximately  $1\frac{1}{2}$  in., close joint tolerances must be maintained. Finally, the parts are heat-treated and proof-tested at a pressure exceeding 4,000 lb. per sq. in.

The copper-brazed assembly, shown in Fig. 19, is an air-conditioner impeller for use in a commercial aircraft. Each vane must be true on the brazing edge and carefully positioned to maintain the metal-to-metal contact required. Tight fits are ensured by using a fixture that applies a load on the vanes. The material is mild steel and brazing is carried out in an exothermic furnace atmosphere.

A standard motor vehicle torque converter repaired by brazing is illustrated in Fig. 20. In service, wear normally takes place on the internal vanes, permitting considerable by-passing of fluid. In repairing these units, a copper alloy is applied to all the joint areas in paste form. Paste



**Fig. 21.** Assembly (left) furnace-brazed with a high-temperature nickel alloy, and machined casting (right), are stainless-steel bodies for aircraft valves having identical temperature and pressure-service capabilities. Brazed body weighs 40 per cent less



Fig. 22. These coaxial hot-air valves for aircraft are made from spun and machined parts of stainless steel, which are joined by nickel-alloy brazing. Nickel-brazed valves have been service-tested at temperatures above 1,200 deg. F.

filler is normally a non-settling suspension of metal or refractory metal oxides in a liquid. The copper in the paste used in this instance was electrolytic powder with a surface oxide contamination of less than 0.4 per cent by weight, which is marketed by the Western Carbide Division of Superweld Corporation under the trade name "Liquid Wire". After the paste has been allowed to dry, the torque converter is brazed in a conveyor type furnace, in an exothermic atmosphere. The heat-treated spline shaft is removed during the brazing operation.

Two butterfly-valve bodies, made by Pneu-Tech Laboratories, Inc., Inglewood, Calif., for use in aircraft and missile hot-air systems, serve to indicate some of the advantages obtainable by the use of furnace-brazing techniques. Both valve bodies, shown in Fig. 21, are made from stainless steel and are physically interchangeable. The valve seen at the right was machined from a casting, and the other was fabricated from machined bar stock and furnace-brazed, with a high-temperature nickel filler alloy.

Although the valve bodies have identical environmental and service capabilities (900

deg. F. and pressures up to 300 lb. per sq. in.), the furnace-brazed type weighs 40 per cent less than the cast unit after being finish machined—a very important consideration in the aircraft and missile industries. The fabrication of valves by brazing has been found particularly economical for short production runs and where early deliveries are required.

Furnace-brazed coaxial hot-air valves, as seen in Fig. 22, have been designed and made by the same company

for use in aircraft. Air passing through these self-operating type units actuates the valve gates. They are constructed from spun and machined parts of stainless steel, furnace-brazed with nickel filler alloy into sub-assemblies. The valves are subjected in service to temperatures of 900 deg. F. and pressures up to 300 lb. per sq. in. Other valves which have been furnace-brazed with nickel filler alloys have been service-tested at temperatures in excess of 1,200 deg. F.

A gas-turbine assembly comprising stainless-steel castings and fabricated components joined by a combination of welding and nickel-alloy brazing is shown in Fig. 23. On assembly, the

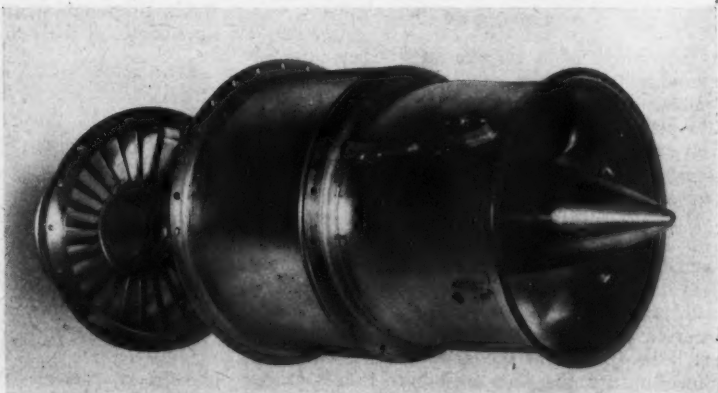


Fig. 23. Castings and other stainless steel components are joined by a combination of welding and nickel-alloy brazing to produce this gas-turbine assembly after they have been tack-welded in position



Fig. 24. This engine block is about to enter a roller-hearth furnace for copper brazing

sections to be brazed must be accurately positioned and all joints are tacked by Heliarc welding. For this high-temperature application, AMS 4775 nickel-alloy filler is employed, and brazing is carried out in sealed retorts, in a hydrogen atmosphere having a dew point of  $-100$  deg. F. At final inspection, all joint areas are examined visually for complete penetration.

The Tyce Engineering Corporation, Chula Vista, Calif., have recently introduced a racing engine for motor car and marine applications, for which the entire block, seen in Fig. 24, is fabricated from sheet steel by copper brazing. The cylinder liners and the valve and head assemblies are in place prior to the operation, and spot welding and staking are employed to hold the various components in position during the brazing cycle. Finish grinding of the cylinders, head plates, and valve guides is carried out after brazing has been completed.

The engine block is made in two types, one of mild steel and the other of stainless steel. An exothermic atmosphere is used when brazing the mild-steel assembly, and a hydrogen atmosphere for the stainless-steel

block. Careful control of the heating rate is necessary in order to reduce the risk of producing gaps or voids that would be difficult to fill with the brazing alloy. In some cases, the entire block assembly is copper-plated and additional filler wire is used to ensure that all joints are completely sealed. Accurate control over the amount of filler employed for this application is important.

### Electron Beam Welding Unit

Rosemount Engineering Co., Minneapolis, Minnesota, U.S.A., have recently been carrying out experiments with an Airco electron beam welding unit, developed by Air Reduction Sales Co., for welding of certain "difficult" materials.

Since the heat for melting and fusing the metal is generated by bombardment in a vacuum with highly accelerated electrons, junctions of very high purity and strength are obtained. Some welds produced are cleaner than the original material, because of the evacuation of gases by the pump.

Materials which have been welded experimentally include tantalum, stainless steel, nickel, tungsten, molybdenum, aluminium, columbian, titanium, and zirconium. A particular advantage of the process is that foils, for example, 0.004 and 0.005 in. thick, can be successfully welded. In the accompanying illustration, an operator is seen adjusting the jig in the vacuum chamber in preparation for welding columbian sheet.



Adjusting a jig in the chamber of the Airco electron beam welder

## Reilly Linear Displacement Transducer Measuring System

BRIEF MENTION WAS MADE IN **MACHINERY**, 98/477—1/3/61, of a new measuring system which has been developed by Reilly Engineering, Ltd., Forsyth Road, Sheerwater, Woking, Surrey, and it is here described in greater detail.

A diagrammatic drawing of the transducer is given in Fig. 1, and it includes a cylindrical capacitance pick-up A, housed in the head B. Separately mounted, so that it extends axially through this head, a cylindrical reference bar is built up from a series of rings as at C, of equal diameter and unit length, which are insulated from each other. Electrical signals are supplied to the individual rings, and the voltage is increased by nominally uniform increments for members at successively greater distances from one end of the bar. It will be seen that the potential of the signal which is thus induced in the pick-up is dependent on the axial distance between the end of the bar and a point mid-way along the pick-up. Moreover, as the latter is of the same length as each ring, it acts as a differential condenser. Consequently, during movement between positions such that it is completely aligned with adjacent rings, the change of voltage, when plotted against distance, follows a line which is virtually straight. Intermediate positions are thus interpolated with considerable accuracy.

The overall accuracy of the system depends principally on that of the rings on the measuring bar.

It will be appreciated that the smallest tolerance which can be maintained during the production of these members is, in general, proportional to their size. Thus, the degree of accuracy obtainable with a bar of given length is directly related to the number of rings employed. Rings are made up to 5 in. long, and to illustrate the variation of accuracy, it is stated that measurements over a range of 10 in. are made to within  $\pm 0.00025$  in. when using rings 2 in. long,  $\pm 0.0001$  in. with 1-in. rings, and  $\pm 0.000015$  in. with  $\frac{1}{2}$ -in. rings.

The bar and the pick-up can be mounted with their axes displaced by an amount up to 0.005 in., and an important advantage of the cylindrical form of construction is that the accuracy is unaffected by errors of parallelism between these members. Such errors in a system that incorporates a flat reference bar and pick-up would result in alteration of the capacitance, due to one end of the latter being closer to the bar than the other. Transducers of the latter type are available, however, for use where lower orders of accuracy suffice, and the bar may be formed, for example, by mounting plates, end-to-end, on a base made from an electrical insulating material, or by depositing a metallic film on glass. The system can also be applied to angular measurement, and for this purpose, electrodes, corresponding to the rings, form segments of a circle, at the centre of which is pivoted the capacitance pick-up unit.

Reference bars can be made in a wide variety of sizes, for checking lengths up to approximately 500 ft., the diameter ranging from  $\frac{1}{8}$  in. upwards, and the rings are normally of stabilized Nitralloy steel, heat treated. If required, they can be hard chromium plated, or, for application where high thermal stability is required, can be made from nickel alloy steel. Together with intermediate insulating washers, the rings are assembled on a tubular

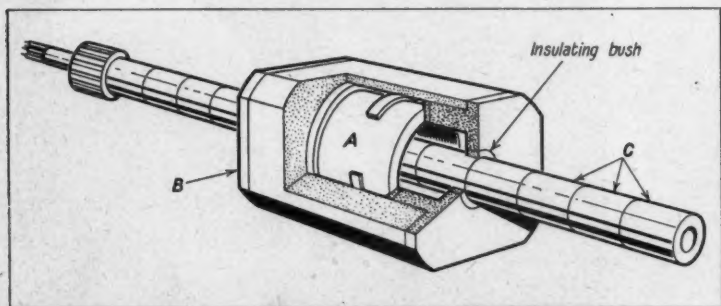


Fig. 1. Electrical signals, at increasing voltages, are supplied to successive rings, as at C, on the reference bar of the Reilly linear transducer, here shown diagrammatically. The potential of the current induced in the pick-up A thus corresponds to the linear position of this member

mandrel, cemented, and then clamped tightly together by means of a nut at one end of the mandrel. The latter is thus placed in tension, and the composite bar is claimed to be stiffer than a plain rod of the same dimensions, and to have greater resistance to deflection when mounted horizontally and supported at the ends. Finally, the surface is ground and lapped. Wires for supplying current to the rings are passed through the bore of the mandrel, to a socket at one end.

The clearance between the bar and the pick-up may be up to 1 in., and for transducer units of medium lengths, is approximately  $\frac{1}{2}$  in. For an application where the bar and the head are attached individually to the stationary and moving members, respectively, of a set-up (probably the most common arrangement), the head is provided with insulating bushes at both ends, which are drilled axially to give a radial clearance of 0.05 in. over the bar. Alternatively, close-fitting bushes can be provided, whereby the head is carried on the bar, but the small operating clearances which must be allowed with this method may permit the head to tilt, and errors akin to parallax may thus be introduced. Designated AH 1, 2, and 3, heads are available with various degrees of sensitivity, and the first two are used in conjunction with bars that are 4 $\frac{1}{2}$  and 8 in. longer, respectively, than the maximum displacement required.

Precautions are necessary to avoid contamination of the reference bar, for example, by swarf or oil, and a housing can be supplied which is suitable for use under average conditions. Plastics bellows-type shields can be fitted, if desired. Alternatively, the transducer can be arranged as a fully-enclosed, self-contained unit, in which the pick-up head is mounted on slideways.

#### ELECTRICAL POSITION-SENSING SYSTEM

To avoid the need for measuring, with a high degree of accuracy, the voltage of the signal induced in the pick-up, the elements of the transducer are connected in an a.c. bridge-type circuit. With this arrangement, the signal is compared with tapplings on transformers, which are selected by means of cascaded decade switches until a balance is obtained, and the position of the head is then indicated by the settings of the switches. Moreover, as the system is phase-sensitive, the direction in which adjustments must be made can readily be determined. It will be appreciated that the system also permits movement of the head to a pre-determined position, as selected by the switch settings.

Toroidally-wound transformers are employed, on account of their high accuracy and stability, and in

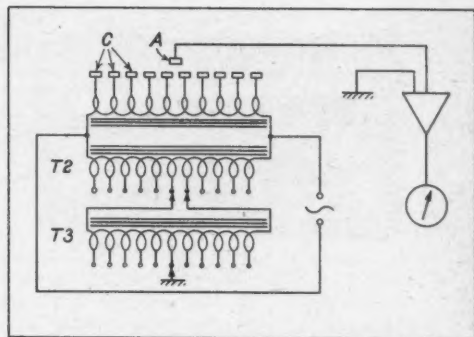


Fig. 2. Rings on the transducer bar are connected in an a.c. bridge-type circuit, and a specimen layout is here shown diagrammatically. The induced signal is compared with tapplings on transformers, which are selected by means of decade switches

the typical circuit shown in Fig. 2, there are two decade switches for selecting the tapplings on the transformers T2 and T3. The latter is connected across one-tenth of the total length of the winding on T2, and as there are ten tapplings on each transformer, the arrangement provides for dividing the total reference signal into 100 parts. Any number of decades can be incorporated, however, and for use with a 10-in. bar, for example, there may be six switches, permitting adjustment in increments of 0.00001 in. Referring again to Fig. 2, it will be seen that the circuit includes a centre-zero meter, for indicating the amount and direction of unbalance. This meter can be calibrated, to enable small displacements to be read directly, and for the example considered earlier, it may have a full-scale deflection of  $\pm 0.0001$  in. The smallest readable movement—approximately 1 per cent of the total—would then represent a displacement of 0.000001 in. Provision can be made for altering the sensitivity, and if desired, large number-display lamps can be connected to the switches, to facilitate reading the settings. These lamps may be mounted in the control unit for the equipment, as shown in Fig. 3, or can be positioned remotely.

Since the method for detecting the position of the pick-up head is purely electrical, the reference point from which measurements are taken (hitherto assumed, for simplicity, to be at one end of the bar) can be shifted by the superimposition of a known signal. For this purpose, a further set of decade switches can be incorporated in the control unit, whereby the zero point may be set accurately anywhere within the measuring range.

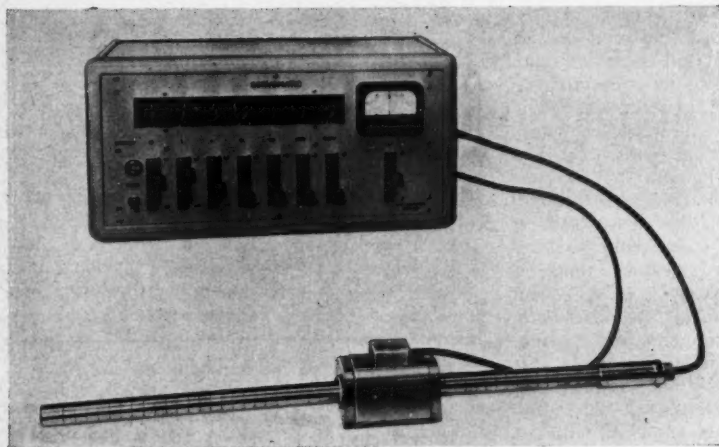


Fig. 3. The control unit for the transducer seen in this illustration incorporates large number-display lamps, to facilitate reading the settings of the decade switches

Provision is made for compensating electrically for the small amounts by which the pitch of the rings on the measuring bar differ from the nominal, and calibration is carried out by means of a number of terminals, which are arranged in sets corresponding to the individual rings and mounted on a board in the control unit. Several pairs of terminals are included in each set, and by connecting a pair to input and output points, in one sense or the other, a known correction is either added or subtracted. Calibration is normally carried out at the company's works, at a temperature of 20 deg. C., but for applications where high accuracy is required, and the bar is composed of  $\frac{1}{8}$ - or  $\frac{1}{4}$ -in. rings, it is recommended that the equipment is calibrated after it has been installed.

#### APPLICATIONS

Certain applications for the equipment were discussed briefly in the earlier article, and a few of these are here considered in greater detail.

For incorporation in machine tools, to indicate the positions of the slides, or enable data to be supplied for fresh positions, equipment whereon the decade switches are adjusted manually is frequently suitable. Alternatively, provision can be made for the automatic adjustment of the switches as the relative positions of the head and bar of the transducer are altered, as may be required for inspection purposes. In a typical inspection set-up, the transducer head is mounted

vertically on a checking fixture, and the bar then serves directly as the measuring plunger. If desired, the readings obtained with such an arrangement can be recorded on punched tape, for example.

By the addition of further equipment, provision can be made for automatic adjustment of the decades from data which are supplied by means of punched cards, tape, or any other convenient recording medium. After a setting has been made in this manner, the error signal obtained from the bridge circuit, which would normally operate an indicating meter, is em-

ployed to control the traversing mechanism for a slide carrying the moving member of the transducer. With two such arrangements, co-ordinate positioning of a machine tool table, for example, is obtained automatically. Equipment can also be incorporated for interpolating between successive switched positions, so that continuous straight-line paths can be traced, and it is anticipated that future developments will provide means whereby the equipment can be used to follow curved paths.

Two transducers, which may be linear, rotary, or one of each type, can be synchronized in any ratio, and such arrangements will be employed in the proposed systems for screw-cutting, and copying from a drawing, mentioned in the earlier article.

**GOODYEAR GREEN SEAL V-BELTS.** Two new types of V-belts have been introduced by The Goodyear Tyre & Rubber Co. (Great Britain), Ltd., Wolverhampton, Staffs. The Green Seal E.C. red V-belt has a 40 per cent higher horse-power rating than the E.C. type formerly supplied, and for the HY-T premium V-belt, the increase in rating is 100 per cent. This latter belt is static-conducting and oil resisting.

It is claimed for the new belts that they have longer life and higher efficiency than the type previously available. In addition, because of the higher ratings, fewer belts and lighter pulleys can be employed for a given drive.

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## Höfler Electronic Inspection Equipment for Gears

ELECTRONIC INSPECTION EQUIPMENT from the range made by Dr.-Ing. W. Höfler Maschinen-und Gerätebau, Ettlingen/Baden, Germany, for checking large gears and gear cutting machines, was demonstrated recently on a Liebherr (German) type L.3200 hobbing machine at the Darnall Works, Sheffield, of Davy and United Engineering Company, Limited—a member company of the Davy-Ashmore group. The demonstration was arranged by Sidney G. Jones, Ltd., 8 Balham Hill, London, who are the sole distributors in this country for Liebherr gear hobbing machines.

During the demonstration, a double-helical gear of 97.919 in. pitch diameter, 1½ d.p., 30 deg. helix angle, and a total face width of 39 in., which had been cut on the Liebherr machine, was inspected before it was removed from the work-table. The gear was cut from a blank in En. 14B steel, and the face width of each set of gear teeth, measured parallel with the centre line, was 16 in.

The Höfler equipment comprises types AAK and EGG I electronic base units incorporating paper strip recorders, to which different measuring heads can be connected by cables for checking gears with pitches up to 20 module, for concentricity, tooth thickness, pitch, straightness of tooth flanks, involute shape, and surface roughness. Attachments are available which enable the individual heads, with the exception of that for measuring surface roughness, to be secured to the cutter slide or the saddle on a hobbing machine, for checking a gear mounted on the work-table.

A separate head can be provided for mounting on the work-table of a hobbing machine or a gear shaping machine for checking the accuracy of the worm drive between the cutter spindle and the table. The range includes another head which enables hobs, worms, and threads to be checked for drunkenness, pitch, tooth or thread thickness, and flank angle, while they are mounted between centres on a grinding machine.

The measuring system comprises a coil with two inductances, which forms one half of an a.c. bridge. The electrical quantity across the bridge is proportional to the position of the core, which can slide within the coil, without making contact with the bore. During the sliding movement of the core, the bridge is brought out of balance. The stylus pins on the measuring heads are held in contact with the work under pressures ranging from 0.1 to 50 grammes (0.003 to 1½ oz.), and the electronic base units enable magnifications from 300 up to as high as 10,000 × to be obtained, so that very small errors can be recorded.

Fig. 1 is a close-up view of the type EVZM measuring head, set up on the Liebherr machine for checking the helical gear for tooth thickness and concentricity. For this operation, the gear is rotated continuously, and a slide on the measuring head is automatically reciprocated to bring a pair of adjustable stylus arms into contact with both

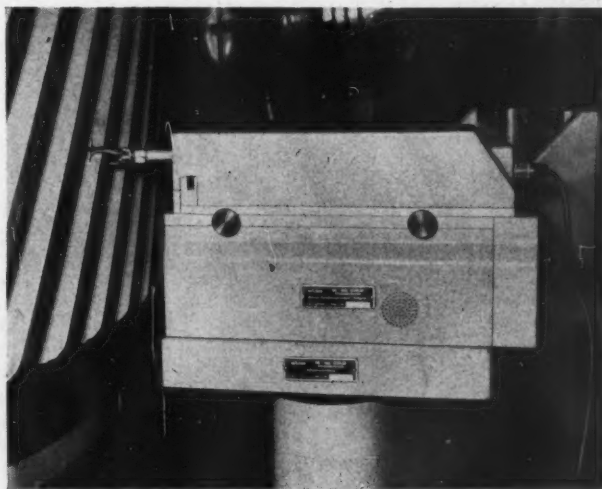
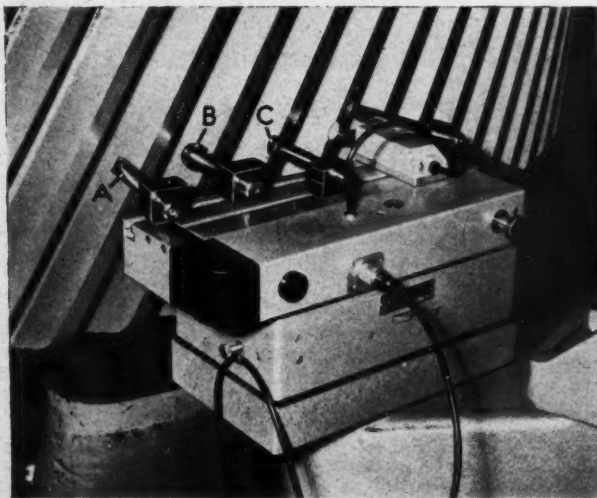


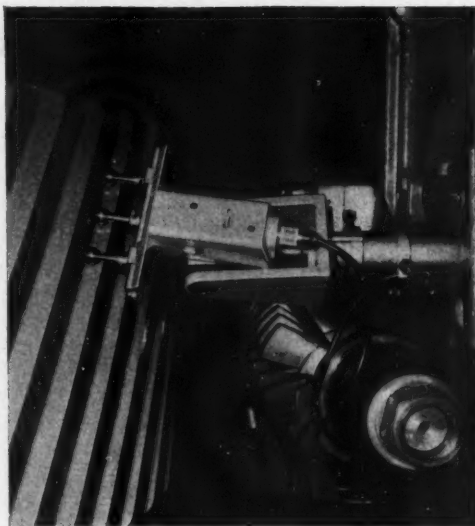
Fig. 1. In this close-up view, the Höfler type EVZM measuring head is seen set up on a Liebherr L.3200 hobbing machine for checking a large-diameter helical gear for tooth thickness and concentricity. This measuring head, and others in the Höfler range, is intended to be connected to an electronic base unit incorporating a paper strip recorder

flanks of each tooth in turn. With this arrangement, the cycle time for checking each tooth may be as short as 1 sec., and readings are marked on paper strip by the recorder built into the type EGG I electronic base unit. The working stroke of the slide can be pre-set by means of knobs at the rear end to suit the diameter of the gear to be checked, and the head can swivel to permit the stylus arms to move with the gear while inspection of the individual teeth is being carried out. Ball-ended stylus arms, also a segment with 3 or 4 gear teeth, can be supplied for mounting on the measuring head in place of the adjustable stylus arms.

The type EZWM attachment, shown mounted on the hob saddle in the close-up view Fig. 2, provides for checking tooth flanks on the gear for straightness. Again, the gear is continuously rotated while checking is in progress, and the hob saddle is traversed in a vertical direction. Mounted in a forked bracket, the measuring head can swivel in two directions at right-angles to each other, under the action of springs, so that two ball-ended pins, which can be adjusted for centre distance, are held in contact with one flank as they are traversed along the helical gear tooth by the movement imparted to the hob saddle. Any deviation from straightness in the tooth flank is measured by a central ball-ended stylus pin, and—again—readings are marked on paper strip by the recorder in the type EGG I base unit.



**Fig. 3.** With this type ETM measuring head, the gear is checked for pitch accuracy between adjacent teeth and for cumulative pitch errors while it is being rotated. In this way, a large-diameter gear can be checked in a fairly short cycle time



**Fig. 2.** The type EZWM measuring head is here seen set up on the Liebherr machine for checking the gear for tooth straightness. Vertical traverse of the hob saddle is applied while the gear is rotated continuously

If required, the measuring head can be detached from the fixing bracket and held by hand for checking a gear for tooth straightness after it has been removed from the hobbing machine. The ball-ended pins are then brought into contact with opposing flanks on a pair of adjacent gear teeth, and the measuring head is held in the vertical position, while it is being traversed by hand across the face of the gear, by a pin attachment which has a wedge-shaped end, and makes contact with the root between another pair of adjacent teeth.

With the type ETM measuring head, which is seen in Fig. 3, mounted on a fixing bracket attached to the hob saddle, the gear can be checked for pitch errors between adjacent teeth, and for cumulative pitch errors, while it is being rotated. In this way a large-diameter gear can be checked for pitch in a fairly short cycle time. Signals obtained from the measuring head while checking is in progress

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are passed to the type AAK electronic base unit, by way of the type EGG I unit. The recorder built into the former unit is so designed that two graphs are prepared simultaneously, one of which indicates pitch errors between adjacent teeth on the gear, and the other, the cumulative pitch errors.

The measuring head comprises a top slide mounted on a lower slide, which is supported by hardened steel bearing balls to ensure easy movement, and the assembly is traversed by hand towards and away from the gear at the beginning and the end of the checking operation on each pair of teeth. Near the ends of the top slide there are two fixed pins, as at A, which have wedge-shaped ends, and engage with the flanks of teeth on the gear to guide the assembly when it is being advanced towards the checking position. When the unit has been brought to this position, the spring-loaded, ball-ended plunger B engages with the opposing flanks of other teeth, and the top slide is then moved with the rotating gear. Checking for pitch accuracy is now carried out by a pair of stylus pins, which engage with the flanks of other adjacent teeth on the gear. One of these pins, as indicated at C, is fixed, and the other, which is spring-loaded, can move sideways and is connected to the EGG I electronic unit.

In addition to helical gears, this equipment may be employed for checking spur gears, worms, bevel gears, and racks, for pitch accuracy. A type ETM/S measuring head is available, which is of basically similar design, but is intended to be mounted vertically for checking gears, the teeth of which have been cut on horizontal-type generating machines.

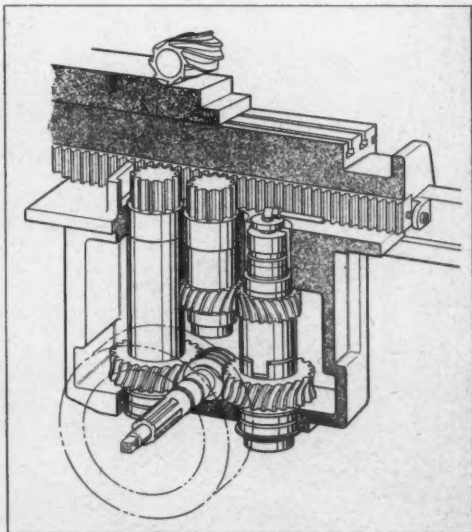
For checking large gears for involute tooth shape, the Höfler type EEM measuring head is mounted on the cutter slide of the hobbing machine, and is connected to the EGG I electronic base unit. A straight-edge on the measuring head is brought into contact with a base circle disc, which is attached to and rotates with the gear mounted on the table of the hobbing machine, and a stylus pin mounted on a vertically adjustable slide engages with the flank of the tooth to be checked.

The measuring heads in the firm's range can also be supplied for operation in conjunction with precision dial indicators. In addition, the Höfler range of electronic inspection equipment includes rolling gear testers. One of these machines, designated type ETMA/F, can be supplied with a maximum of four master gears with independent measuring heads, for checking, simultaneously, multiple elements of cluster gears.

## The Cincinnati Hydramech Table Drive

The accompanying illustration shows the arrangement of the Hydramech table driving unit now used on HyPowermatic milling machines built by the Cincinnati Milling Machines, Ltd., Kingsbury Road, Tyburn, Birmingham, 24. Enclosed within the bed, for protection against dirt, the unit incorporates a hydraulic motor with a steplessly-variable speed control, which drives a worm shaft. The worm drives two wormwheels, that on the left being mounted on the shaft of a pinion which is engaged with the table-driving rack. The second wormwheel transmits drive through a helical gear which can be moved downwards axially, against the pressure of a spring, by a hydraulic cylinder above. This gear meshes with a similar gear on the shaft of a second pinion, also in mesh with the table rack.

When backlash is to be eliminated, pressure is applied to the cylinder, to thrust the movable gear downwards. This action results in the turning of the second pinion shaft slightly, in a direction opposite to that in which the first pinion rotates. Opposite faces of the teeth of the two pinions are thus held in contact with the rack teeth, so that all backlash is taken up.



Cut-away drawing showing the arrangement of the Hydramech table drive unit employed on Cincinnati HyPowermatic milling machines

# Drilling Printed Circuit Boards

Methods Employed at G.E.C. Telephone Works, Coventry

By A. J. LOLE, B.Sc. (Eng.), A.M.I.Mech.E.

THE USE OF PRINTED CIRCUIT BOARDS in the telecommunication and allied equipment made at the Telephone Works of the General Electric Co., Ltd., at Coventry, has gradually increased during recent years, and in this connection the problem arose of developing the most economical methods of producing the holes for mounting components on the boards. As distinct from the more familiar position in the radio and television industry, where the quantities involved justify the use of individual piercing tools, the requirements at these works are for small batch quantities (of boards) of a comparatively large variety of designs.

This problem has been solved in two ways, both of which involve drilling as the means of producing the holes, to avoid the comparatively high cost of piercing tools. For the first solution, it was decided to attempt to eliminate individual tooling for each board and the selected method of

achieving this result involves the use of an electronically-controlled machine for automatically positioning and drilling. With a knowledge of the production rate required, it soon became obvious that a single-spindle machine would not suffice, and a specification for the required machine was therefore drawn up by the Works Technical Services Department, who were responsible for the development, construction, and installation of the machines described in this article. The final form of this specification called for a 7-spindle drilling machine, actuated by the same electronic equipment which controlled the positioning of the work-table to within an accuracy of  $\pm 0.002$  in.

The whole field of electronic control of machine tools was surveyed, and a proposal to design and make the necessary control equipment at G.E.C. was carefully considered. However, the final choice lay with equipment which had already

passed the development stage and was available as a proved design—namely, the Emicon type C.1010 electronically-controlled positioning system made by E.M.I. Electronics, Ltd., Hayes, Middlesex.

This electronic control system was applied to a specially-designed co-ordinate table, with moving members which are carried on recirculating ball guides and are actuated by hydraulic cylinders, the high pressure oil supply being derived from compressed air from the normal shop supply (65 lb. per sq. in. min.). The fine measuring system is based on an Emicon inductor with an electrical accuracy of  $\pm 0.0005$  in., which pro-

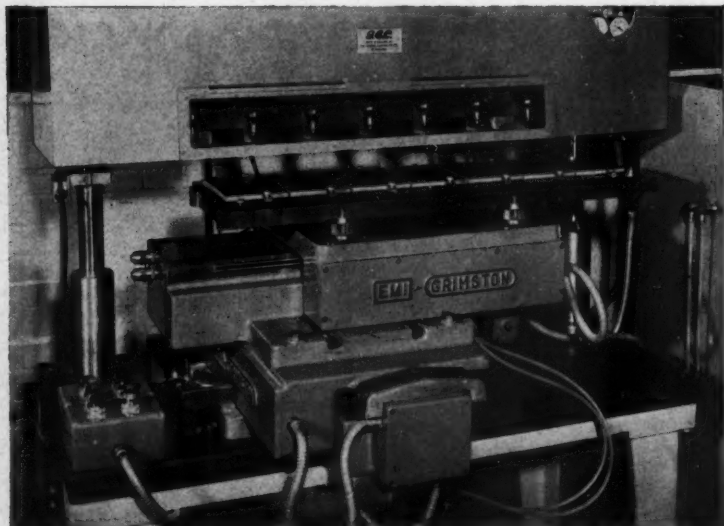


Fig. 1. This special drilling machine for printed circuit boards, which was constructed by the G.E.C. Telephone Works, incorporates an E.M.I. Grimston tape-controlled positioning table



**Fig. 2.** After the hole co-ordinates have been tabulated in the required order, the tape is punched on a Creed machine

vides for a guaranteed positional accuracy of the table of  $\pm 0.002$  in. with repeatability to  $\pm 0.001$  in. Information can be fed into the control system either by means of 5-hole paper tape or by manually setting dials on the control cabinet.

The system operates as follows:— the  $x$  ordinate is read and the table is moved in the  $x$  direction and is locked, the  $y$  ordinate is read and the slide is moved in the  $y$  direction and locked, a signal actuates the spindle feed, and the drilling operation takes place. For the next position, the cycle is repeated, the reading of the  $x$  ordinate starting during the retraction of the drill spindles.

As seen in Fig. 1, the co-ordinate table was built into a drilling machine designed and built at Telephone Works. This machine incorporates seven Desoutter pneumatic drills mounted on a cross-beam which is traversed vertically by means of a pneumatic system operated directly from the shop compressed air supply. Ransome and Marles recirculating ball bushings are employed to maintain the alignment of the cross-beam. The normal capacity of the table is 10 in. by 10 in., but for this application the capacity is restricted in one direction

to 7 in. by the spacing of the drills. This distance, however, is sufficient to cover the size of the boards in use.

The printed boards are located at all stages of the production process from datum holes which are provided when the blanks are made. Thus, when loading the fixture, it is merely necessary to locate these different-sized datum holes on pins. Seven packs, each of five boards, forms a load. Duplicate fixtures are provided so that one can be unloaded and reloaded while the other is in use, to permit maximum machine utilisation.

Holes in the boards for which this equipment is used are all of one size, namely 0.052 in. diameter, and the drills employed are made with a special helix angle for Bakelite, and a point angle of 60 deg. The speed of the drills can be adjusted by means of a reducing valve in the air supply circuit, and the most efficient running speed has been found to be 10,000 r.p.m. Although the number of holes per board varies considerably, the average is 120. The machine time cycle required for such a board is approximately 36 min. or slightly more than 1 min. per board. In this connection, however, it should be borne in mind that unloading and loading of the fixtures and inspection of the drilled boards are carried out while drilling is in progress.

For a particular type of circuit board, the drilling time will depend on the pattern of the holes, which determines the path to be traced on the



**Fig. 3.** When drilling larger circuit boards, time is saved by the use of this air-flotation jig base

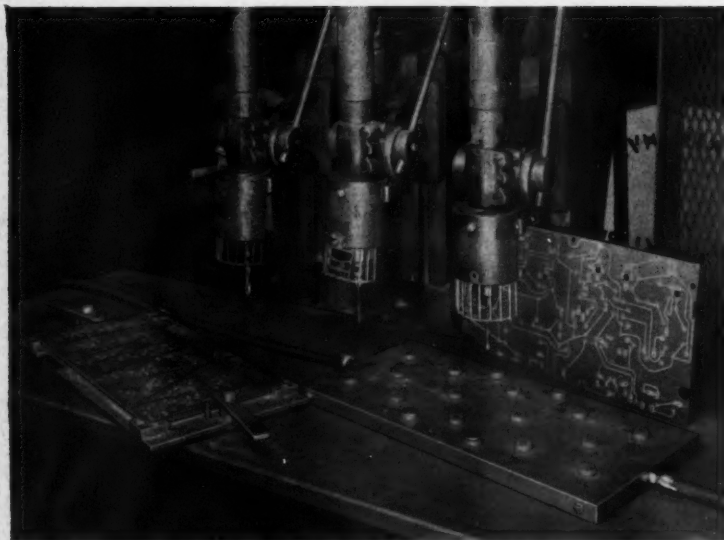


Fig. 4. The jig is retained in position on the base by a number of circular magnets

board from hole to hole, and the time required to follow that path.

Choice of path to be traced is the responsibility of the production engineer, and he marks on the drawing the path chosen and tabulates the  $x$  and  $y$  co-ordinate values for the various holes. The drawing is then passed to the office typist who punches the  $x$  and  $y$  co-ordinate information for each hole, in turn, into the tape, using a Creed tape perforator, as seen in Fig. 2.

The main advantage of this equipment is the facility that it affords for drilling the printed circuit boards at a very economical rate and with a minimum tool cost—the cost of the tape. This advantage, as compared with conventional methods, has been well demonstrated during the development of one particular piece of equipment which involved frequent changes in the design of the boards. Such changes would have necessitated comparatively expensive tooling modifications in the normal way, but with the equipment here considered, it was merely necessary to provide new tapes.

A second method of drilling was developed mainly for printed circuit boards of sizes beyond the maximum capacity of the tape-controlled machine, which, again, are required in quantities too small to justify the use of press tools. Conventional plate-type drill jigs were being employed on standard pillar drilling machines, but owing to

the size and weight of the jigs, stoppages due to drill breakage were frequent.

#### JIG WITH AIR-FLOTATION BASE

The air-flotation principle had been used several times previously in connection with special-purpose machines made at Telephone Works, and it was decided to apply it in this case. A jig base was so designed as to enable compressed air from the shop supply to be directed to an escape hole at each corner, the weight of the base and jig being thus supported on a cushion of air. This jig base, with a jig in position, is seen in use in

Fig. 3. A reducing valve was provided in the compressed air line to enable the pressure of the supply to the base to be reduced to the 10 lb. per sq. in. (maximum), which has been found to be sufficient for the purpose. The floating base is fitted with eighteen circular magnets, as seen in Fig. 4, arranged in a pattern that will accommodate different sizes of jigs. These magnets are sufficiently powerful to hold the jigs during the drilling operations, but permit them to be removed easily when required.

It was necessary to fit to the standard drilling machine an auxiliary table, planed flat, and without holes or slots, and sufficiently long to enable the jig base to be used with any spindle of the machine without overhang. Air is supplied to the floating base by way of copper tubing, which is located beneath the auxiliary table, and by flexible tubes that are fitted with Schrader "quick-action" connectors.

Experience of drilling various boards with this equipment has shown that savings in operating times as compared with those required when using conventional arrangements are considerable, and vary with the distance between holes. In general, the "air-flotation" equipment has proved so successful that further sets have now been made, and their application has been extended to tooling for the production of components other than printed circuit boards.

## Slideway Grinding Operations on a Lees-Bradner Hobbing Machine Bed

AS AN INDICATION OF THE ACCURACY obtained by slideway grinding operations performed at the works of the Lees-Bradner Co., Cleveland, Ohio, U.S.A., it is stated that the bed of an 8- by 102-in. spline hobbing machine, recently supplied to the Giddings & Lewis Machine Co., was finished to a limit of 0.0005 in. for straightness and flatness from end to end, and to the same limit for twist on the diagonals. The bed of this machine is 144 in. long, and has the cross-sectional form indicated in Fig. 2.

Bed surfaces to be ground are first machined by planing, an allowance of 0.015 to 0.016 in. being left for finishing. Subsequently, the casting is stress relieved and the slideways are flame-hardened to 50-52 Rockwell C. The first grinding operations on the spline hobbing machine castings provide for facing the pads on the swarf tray and the under-sides of the bed feet. Next, the swarf tray is bolted to the bed, and the assembly is clamped to the table of a heavy-duty Hill-Acme

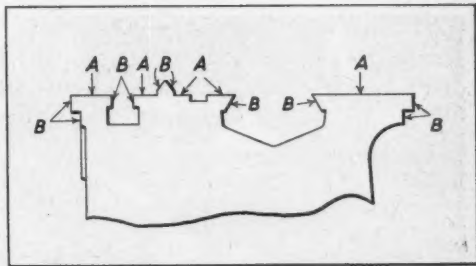


Fig. 2. Diagrammatic cross-sectional view of the bed, for a Lees-Bradner 8- by 72-in. spline hobbing machine

plano type machine, close-up views of which are given in Fig. 1 and 3. On the cross-rail of this machine are mounted two Pope grinding heads. One of these heads, seen in Fig. 1, is employed for grinding all the horizontal surfaces A, Fig. 2. The horizontal spindle is carried in a flanged cartridge and is driven by belt from the motor mounted above. Run-out of this spindle, it is stated, does not exceed 0.00005 in. Of the tilting type, the second grinding head, shown in Fig. 3, is employed for the vertical, angular, and under-surfaces indicated at B in Fig. 1, including the vertical faces of the T-slot throat. The spindle is driven by a 7½-h.p. motor at 3,600 r.p.m. and a special extension arbor permits of grinding surfaces that would otherwise be inaccessible.

After the horizontal portions have been rough ground, the tilting head is employed for roughing the remaining surfaces. Finish grinding is then carried out in the same order, with finer wheels and lighter cuts. On certain surfaces, the final passes are made with a fairly coarse, hard wheel, to produce a pattern of the form seen in Fig. 4. The horizontal surfaces, however, are ground smooth. While the bed is still in position on the machine table, the ground surfaces are inspected for dimensions,



Fig. 1. The bed and swarf tray assembly for the hobbing machine is here shown clamped to the table of the Hill-Acme slideway grinder. All horizontal surfaces are ground with a Pope horizontal spindle head

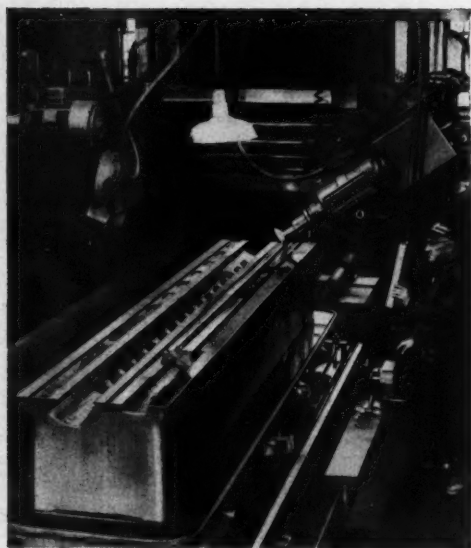


Fig. 3. This Pope tilting head, for which an extension arbor is provided, is employed for grinding various angular, vertical and under surfaces

squareness, and straightness, with indicators, some of which have magnetic bases.

The time required for grinding the bed of the 8- by 72-in. spline hobbing machine is 22.5 hours, and for the saddle surfaces, 6 hours.

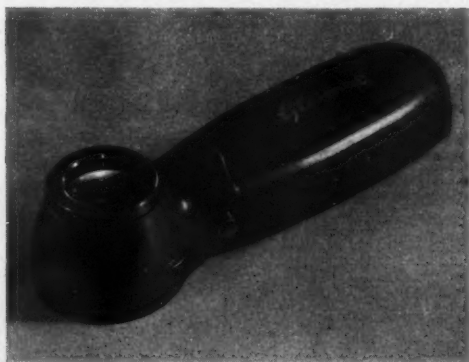


Fig. 4. A smooth ground finish is produced on the horizontal surfaces and a "criss-cross" finish on the angular surfaces, as here shown

To prevent wringing between the bed surfaces and those of the saddle of the assembled machine, a special lubricating system is provided. This Lincoln Centro-Matic system incorporates a sealed plastics reservoir containing way-lubricating oil, which is mounted in a convenient position on the machine base. Compressed air is admitted to the top of this reservoir to force the oil through rigid and flexible tubes to the saddle. Holes are provided in the saddle bearing surfaces through which oil is delivered under pressure, and the saddle is thus supported on an oil film. The pressure is adjusted to provide for a very slight amount of "bleed" which ensures flotation of the saddle and serves to prevent entry of any abrasive material between the mating surfaces.

### Glo-Mag Illuminated Pocket Magnifier

Combined Optical Industries, Ltd., Plasta Works, Slough, Bucks., have recently introduced the Glo-



Glo-Mag illuminated pocket magnifier

Mag illuminated pocket magnifier shown in the accompanying figure. The unit incorporates a lens, of 11 $\times$  magnification, which is mounted in a plastics case, designed to fit comfortably into the hand.

A bulb is mounted within the plastics case, below and to one side of the lens, and serves to illuminate the object that is to be inspected. Power for the bulb is supplied by two type U.12 batteries in the handle portion of the case, and is controlled by a thumb-operated push-button switch. The unit is designed to be held close to the eye, and weighs only 2 oz., complete with batteries. It is available in three colours, namely maroon, green and blue.

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# Protection of Electrically-driven Machine Tools

By J. L. WATTS, A.M.I.E.E.

PROTECTIVE DEVICES for electrical equipment are required to limit damage to plant in the event of failure of insulation, overload, or faulty functioning; to guard the operator against the risk of electric shock or unexpected starting of a machine; and to reduce risk of fire. Efficient protective arrangements must discriminate between normal and abnormal conditions, also between transient and sustained conditions.

## HEATING AND LOADING

The rate of heating of a motor or conductor is proportional to the square of the current value. Whereas cables will normally carry currents appreciably greater than the rated values for limited periods without failure, the life of a modern motor may be very seriously reduced if the rated current is exceeded. Motor currents may increase for various reasons.

Mechanical overload may occur if the rotor of the motor rubs on the stator because the bearings are worn, if the machine is run at too high a speed for a given operation, if depth of cut or rate of feed is too high, or if the machine is inadequately lubricated or incorrectly adjusted. Such an overload will automatically increase the current taken by a motor, the current being the same in each supply line to a 3-phase motor. It is not always appreciated that low voltage at the motor terminals will have a similar effect. This situation may arise if the motor is of the wrong voltage for the supply, if the supply voltage is low, if the tappings used on the supply transformer are incorrect, or if there is an excessive volt drop because the supply cables to the motor are too small.

As may be seen from the curves A and C in Fig. 1, the current taken, and the torque produced, by an induction motor operating on a given voltage depend on the speed at which the motor is running, which is automatically adjusted until the torque is equal to the resistance torque of the load. Curve C shows that, on normal voltage, this particular motor will run at 95 per cent of its synchronous (no-load) speed, and will take its rated full-load current. If the resistance torque of the load remains constant and the voltage

applied to the motor falls to 90 per cent of rated value the speed of the motor will fall to 93.5 per cent of synchronous speed. The motor current may then increase, as shown by the intersection of the curves B and C, with the result that the motor may be damaged by overheating.

## INCOMPLETE STARTING

Serious overheating, with equal excess currents in each phase, may occur if the starting operation is not completed due to a defect in the starter or for some other reason. For instance, if an auto-transformer starter remains in the starting position the motor will continue to run on the reduced (starting) voltage from the auto-transformer, and there will be excess current in the motor windings. In these circumstances, the auto-transformer may also be damaged because it is not cut out of circuit. Similar trouble might occur with a line-resistor starter.

A star-delta starter connects the stator windings

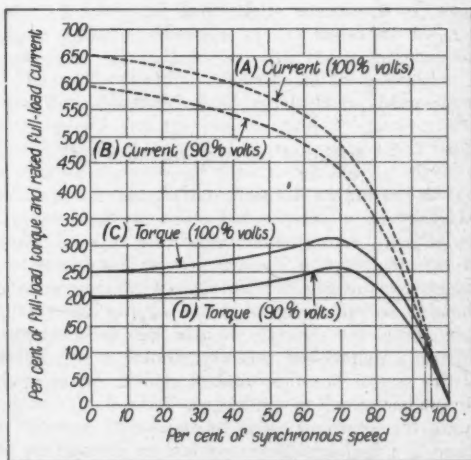


Fig. 1. Curves showing the speed-torque and speed-current characteristics of a typical 3-phase squirrel-cage induction motor

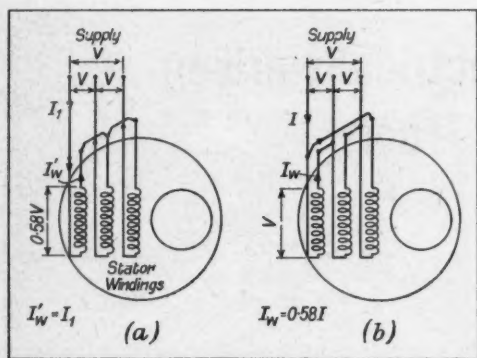


Fig. 2. Star and delta connections of 3-phase stator windings

of the motor in star during starting, as at *a* in Fig. 2, and 58 per cent of line voltage is then applied to each phase of the motor windings, and the full line current is carried by each winding. In the running position, the stator windings are connected in delta, as at *b* in Fig. 2, line voltage being applied to each winding, which then carries only 58 per cent of the line current input to the motor. Curves *C* and *D* in Fig. 3 show that if a motor is run on 90 per cent of full-load torque with the starter in the starting (star) position, the speed may be about 80 per cent of the synchronous value instead of 95 per cent. The line current input to the motor might then be about 140 per cent of its rated value, and each winding might be carrying about 240 per cent of the value that it was designed to carry on full load. The windings would quickly burn out under these conditions.

#### EFFECT OF UNEQUAL VOLTAGES

The current in the different phases of the stator windings of a polyphase motor may be very unequal, with consequent overheating of some parts of the windings, if the voltages at the motor terminals are unequal. This situation may arise if there is an open circuit in one supply line to the motor, due, for example, to a broken or fused conductor, a melted fuse, a faulty connection or contact in the starter or other control switch, or an open circuit in the motor windings. The voltages at the motor terminals may also be somewhat unequal if there is a high-resistance contact or connection at some point in the supply to the motor, if single-phase loads are unequally distributed between the phases, or if there is an open circuit on a main circuit, with a running motor on the load side.

#### STALLING AND INSULATION FAILURES

An open circuit in one phase of the supply to an individual 3-phase motor, or an open circuit in one phase of star-connected motor windings, will prevent the motor from starting when switched on, and a high current will then pass through parts of the windings. Similarly, dangerously high currents will pass through the motor if it remains stalled when switched on, whether due to overload, reduction of torque output on account of low voltage, or some other cause. Fig. 1 shows that the starting torque of an induction motor is approximately proportional to the square of the voltage.

Excess current may also flow through motor windings and connecting cables, in the event of a short circuit (failure of insulation between conductors) or an earth fault (failure of insulation between a conductor and its earthed casing). In the latter case, the fault current will depend on the point at which the fault occurs and on the impedance of the earthing circuit.

#### OVER-CURRENT PROTECTION

It will be seen that the types of faults which have been mentioned all involve some increase of current in the motor windings, and in the cables. Protection against excess currents may be afforded by means of fuses, or overload releases which control a circuit-breaker such as the motor starter.

A fuse will not melt with less than 125 to 200 per cent of its rated current, depending on its design. The line fuses must be large enough to

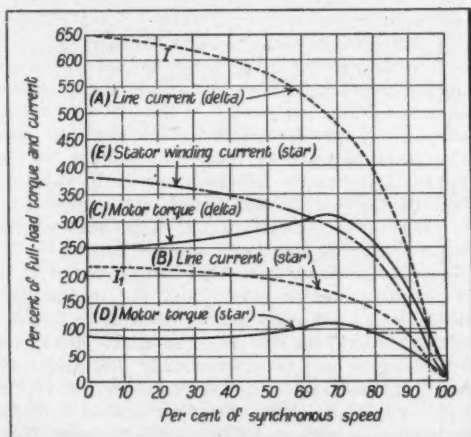


Fig. 3. Current and torque curves for a 3-phase motor with star-delta starter

carry the comparatively high starting current of the motor without melting, which means that their current rating may have to be in the region of three times the full-load current of the motor. Thus fuses cannot give protection against small overloads which may be sufficient to damage the motor. The function of the fuses is to protect the supply cables, the starter, and the motor, against quite high currents which might result from a short circuit or an earth fault. The accompanying table shows suitable fuses for most 415 volt 3-phase motors.

**SUGGESTED FUSES AND MAXIMUM IMPEDANCE OF EARTH-FAULT LOOP FOR 415 VOLT 3-PHASE MOTORS**

Rated horse-power of motor	Motor with direct-on-line starter			Slip-ring motor, or motor with star-delta, auto-transformer or line-resistor starter		
	Rating of cartridge fuse (amp)	Number and size (s.w.g.) of tinned-copper fuse wires	Maximum impedance (ohms) of earth-fault loop	Rating of cartridge fuse (amp)	Number and size (s.w.g.) of tinned-copper fuse wires	Maximum impedance (ohms) of earth-fault loop
1	6	1-34	13.3	6	1-34	13.3
2	10	1-29	8	6	1-34	13.3
3	15	1-25	5.3	10	1-29	8
4	15	1-25	5.3	10	1-29	8
5	25	1-22	3.2	15	1-25	5.3
6	30	1-21	2.6	15	1-25	5.3
7½	30	1-21	2.6	15	1-25	5.3
10	50	1-18	1.6	25	1-22	3.2
15	60	1-17	1.3	30	1-21	2.6
20	80	1-15	1	50	1-18	1.6
30	100	1-14	0.8	60	1-17	1.3
40	160	2-15	0.5	80	1-15	1
50	200	2-14	0.4	100	1-14	0.8
60	200	2-14	0.4	125	2-17	0.6
75	200	2-14	0.4	160	2-15	0.5

#### EARTHING

When an earth fault occurs the frame of the defective apparatus, and of other apparatus bonded to it, becomes "alive" at a certain voltage to earth. The current will only be cut off by a fuse if the impedance of the earthing circuit is sufficiently low to allow the fault current to reach the melting value of the fuse. Thus, for protection against electric shock risk, fuses should be no larger than is necessary, and the earth-fault loop should have low impedance. Columns 4 and 7 of the table give the maximum permissible earth-fault loop impedance values for 415-volt 3-phase circuits, for the various sizes of fuses, on a supply with the neutral point earthed. For a given size of fuse, the maximum permissible earth-fault loop impedance is proportional to the phase-to-earth voltage of the supply. The impedance should be tested by a competent electrician when the plant is installed, and at intervals afterwards.

#### FUSES AND CABLES

Although it is generally desirable to provide one set of fuses for each motor, it is permissible to provide only one set for all the motors on one machine tool, provided that the rating of the fuses is not more than 100 amps. In such circumstances, the current rating of the fuses must be no greater than four times the rated full-load current of the largest motor plus the sum of the current ratings of all other motors on the machine which may be in operation at one time. With such an arrange-

ment, moreover, the cables to any of the motors must not be less than 0.003 sq. in. (3 x 0.036 in. diameter), and must have a current rating not less than the rated current of the motor supplied. In addition, all motor cables must have a current rating at least one-third of that of the cables feeding the main fuses for the machine.

The risk of an open circuit or a high resistance may be reduced by good installation, all bolted and screwed connections which may be subject to vibration, being secured with lock nuts or spring washers, with proper cable connectors, and by ensuring that the fuses of a set protecting a 3-phase motor (or motors) are of the same size in each pole.

To avoid open circuiting due to the melting of a main fuse should a fault occur on a low-current single-phase control circuit, and to protect the latter circuit, it is desirable to provide small fuses in control circuits and control transformer circuits. Where a control circuit or transformer is connected between two phases, a fuse should be provided in each phase, but a fuse should only be included in the phase lead to a control circuit or transformer which is connected between one phase and neutral. One point on the secondary winding of such a control-circuit transformer should be earthed, and a fuse, or fuses, should also be provided on the secondary side of the transformer.

#### OVERLOAD PROTECTION

To protect a motor against comparatively small excess currents it is necessary to include one overload release element for each phase of each 3-phase motor. Some motors have a C.R.P.O.

rating (continuous rating permitting overload), whereas others have a C.M.R. rating (continuous maximum rating). Protection of a motor of the former type requires an overload release which will operate in the event of a sustained overload 25 per cent in excess of the full-load current of the motor. For C.M.R. motors, the overload releases should operate on about 10 per cent excess current.

These devices, however, must have time lag, to ensure that they are not operated by momentary high current values which do not persist long enough to damage the motors. Such protection may be afforded by magnetic overload releases with time-lag dash-pots or by thermal overload releases. The former have the advantage that the operating current and time lag can be adjusted independently. With a thermal overload release, the operating time, especially if it is independently heated, may be rather too long to afford adequate protection against faulty starting of a cold motor. Time lag of these releases, moreover, varies with the ambient temperature, unless there is provision for automatic compensation. For the full protection of a C.M.R. rated motor, a comparatively short time lag is required with high current, such as may be provided by a magnetic overload release with the characteristics indicated in Fig. 4.

Since the ratio of winding current to line current during starting is not the same as when running, if a star-delta or an auto-transformer starter is used, it is suggested that overload releases connected in series with the motor windings, instead of in the lines, would afford better protection against faulty

operation of such starters. This arrangement would also provide better protection against an open-circuited supply line to a delta-connected stator winding. With such connections, the rating of the overload releases should, of course, correspond to the full-load current in the stator windings.

A motor may also overheat without any increase of current if the cooling is inadequate. This situation may arise if the motor is enclosed in a confined space, or if there is an accumulation of foreign matter, externally or internally. A short-time rated motor may also overheat on normal load if run for more than the rated period. Overload releases are operated by current and cannot, therefore, protect a motor against such causes of overheating. Also, they cannot ensure protection against too frequent starting of a motor, and they may be unable to provide an efficient safeguard if the load varies widely during an operating cycle.

For protection under such conditions, a thermal device may be fitted in the motor to switch off the starter if a dangerously high temperature is reached. It may be necessary, with such a device, to incorporate a small heater, which carries the motor current or a proportionate current, to compensate for the temperature gradient through the insulation. If it is to be used with a coil-operated starter, such as a push-button type, the device should be so designed that it must be manually reset after it has operated, to avoid risks which might arise if it automatically re-started the motor after it had cooled down.

#### UNDER-VOLTAGE PROTECTION

With the possible exception of certain units of less than 0.5 h.p., the starter for each motor should have an under-voltage release. The main function of this device is to switch off the motor if the supply fails or the voltage falls below 85 per cent of the rated value, to prevent automatic re-starting of the motor when the supply is restored to normal. An under-voltage release also constitutes the means whereby many overload releases and emergency controls can switch off the motor, and it forms part of the sequence and timing system of control gear which ensures correct starting of a motor or motors. A stop push-button should preferably be designed so that it can be locked in the off position by turning the knob after it has been pressed.

#### TIMING DEVICES

Automatic timing devices form an important part of the protective systems of machine tools, being designed to ensure correct starting, to avoid ex-

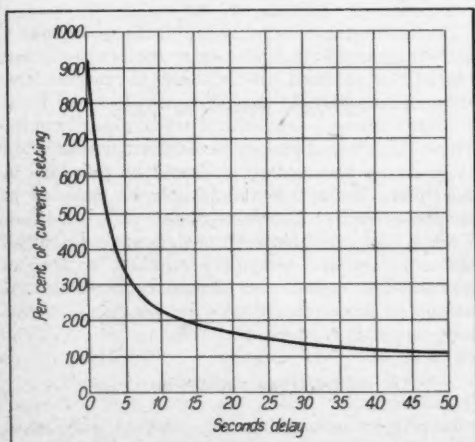


Fig. 4. Time-current characteristics for a magnetic over-current release with time-lag dashpot

cessive current peaks or torques, and to eliminate overheating of starting gear. Such a device may be of the thermal type, with a bi-metallic element which is electrically heated to control contacts after a pre-set period. Alternatively, contacts may be operated by an electromagnetic coil controlled by an air or oil dash-pot or an eddy-current timer, or by a pendulum escapement. In some cases, the contacts are driven by means of a small synchronous motor.

Certain timing devices have a definite time lag on each setting, and others are partly controlled by the load on the motor. In general, each device should be adjusted to bring in the next starting stage as soon as the motor has accelerated to a steady speed on the former stage.

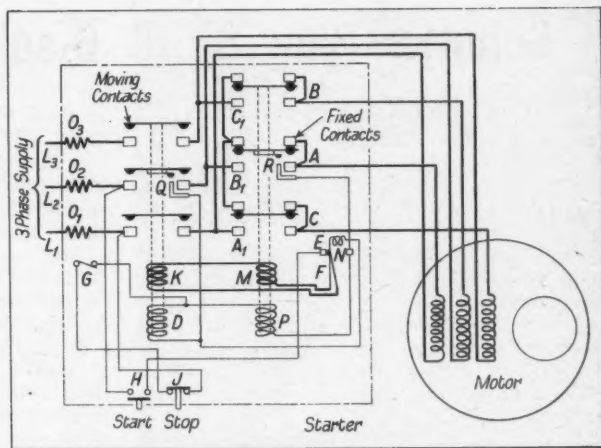


Fig. 5. Connections of one type of automatic star-delta starter

#### AN AUTOMATIC STAR-DELTA STARTER

Fig. 5 shows the connections for one type of push-button controlled, star-delta starter, with two air-break contactors. When the start push-button is pressed, the coil *D* of the line contactor is energized, from the supply lines *L*<sub>2</sub> and *L*<sub>1</sub>, through *H*, the contacts *E* of the bi-metal timing relay, the overload release contacts *G* and the stop-button contacts *J*. The line contactor then closes to connect the supply lines to the ends *A*<sub>1</sub>, *B*<sub>1</sub>, and *C*<sub>1</sub> of the motor windings, the other ends *A*, *B*, and *C* being connected together through the contacts of the de-energized star-delta contactor. The motor now starts in "star," the contacts *Q* keeping the coil *D* energized after the start push-button has been released.

Voltage is then induced in the secondary winding *K* of the line contactor and is applied to the secondary winding *M* through the bi-metal strip *F*. In a few seconds, the strip moves to open the contacts *E*, and close *N*, to energize the coil *P* through *Q*. As a result, the star-delta contactor opens the star connections and connects the ends *A*, *B*, and *C* in delta. Voltage induced in the secondary winding *M* then opposes that from *D* and reduces the current through *F* so that the bi-metal strip returns to the starting position. In the event of supply failure, the coils *D* and *P* release their contacts. The motor is also switched off if the stop push-button is pressed, or if excessive current through the bi-metal overload elements *O*<sub>1</sub>, *O*<sub>2</sub>, or *O*<sub>3</sub> causes them to open the trip contact *G*. The time lag of the timing relay *F* may be adjusted by means of a screw.

#### ISOLATION

An isolating switch should be provided on or near each machine tool so that all unearthed supply conductors can be opened to cut off the supply from the machine, when required. Certain circuits, however, for example for lighting on a machine or for electromagnetic chucks, which it may be undesirable to de-energise, may be fed from the "live" side of the main isolating switch, provided that independent isolating switches are fitted near the main isolator to control these circuits, and that the isolating switches are labelled. The isolating switch may incorporate the main fuses, if required.

**USE OF DELRIN IN PUMP CONSTRUCTION.** It is reported by Du Pont de Nemours International, S.A., 81 Route de l'Aire, Geneva, Switzerland, that a general purpose gear pump, made almost entirely from Delrin acetal resin, has been introduced by Planet Products, Chicago, Ill., U.S.A. The pump has a maximum delivery capacity of 18.5 gal. per min., and can be operated at pressures from zero to 100 lb. per sq. in. Advantages claimed for this pump include high efficiency, low heat build up, good bearing characteristics without lubrication (other than that provided by the fluid being pumped), quiet operation, and long life. Independent tests, it is stated, have shown the horse-power may be reduced by as much as 50 per cent, compared with that required for a conventional metal pump. The moulded components can be produced economically in quantity.

## Schütte Type SE.16 6-spindle Automatic

THE TYPE SE.16 6-SPINDLE AUTOMATIC shown in Fig. 1 is the latest addition to the range built by the German firm of Schütte, for whom Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2, are sole distributors in this country.

Cycle times as short as 2 sec. can be obtained on this machine, which has a capacity for round bars up to  $\frac{3}{4}$  in. diameter, square sections up to  $\frac{1}{2}$  in., and hexagons up to  $\frac{1}{2}$  in. across flats. A maximum bar feed movement of  $\frac{1}{4}$  in. is obtainable, and settings are made by means of an adjustable arm in conjunction with a quadrant, which is fitted with a scale.

The slides for end-working tools are in the form of cylindrical quills mounted in hardened steel holders, which can be adjusted in a direction parallel with the spindle axes in guideways on the stationary central carrier. These slides have a working travel of  $2\frac{1}{2}$  in., and a total movement of 3 in. As on other automatics in the Schütte range, different feeds can be applied to the individual slides during the working cycle, if required, the motions being derived from separate cams, through adjustable crank mechanisms and push rods. When sensitive cutting tools are to be employed, special safety push rods can be fitted to restrict the maximum thrusts that can be applied to the slides. Two push rods can be provided, in addition

to those for actuating the slides for end-working tools, and may be employed, for instance, for operating turning attachments mounted on the cross-slides. A cross-slide is provided at each spindle position, and the working stroke and total travel are  $\frac{1}{2}$  and  $1\frac{1}{2}$  in. for the two upper slides,  $\frac{1}{4}$  and 2 in. for the intermediate slides, and  $\frac{1}{2}$  and 2 in. for the lower slides. Traverse movements for the cross-slides and the slides for end-working tools are controlled, positively, by stops.

A total of 45 spindle speeds ranging from 400 to 5,000 r.p.m. is available, the drive being taken from a 10-h.p. motor, through V-belts, to a first motion shaft, and thence by gearing to the spindles, which run in precision anti-friction bearings. From the first motion shaft, drive is transmitted by change gears and clutches which give feed and rapid power traverse movements for the tool slides, and through worm gearing to the camshafts. The cams for operating the slides for end-working tools rotate in the horizontal plane, and are positioned close to the front of the machine, and the change gears are mounted on spindles at the end of the bed. Doors on the end housing afford easy access to the cams, crank mechanisms and change gears, for setting up. A disc-type brake, which is connected to the feed clutch through a dog clutch, is applied to the worm shaft when the feed motion of the machine is disengaged.

When the tool slides are required to be operated by hand, for setting up, the dog clutch, and consequently the brake, is disengaged by means of a lever, and the worm shaft can then be turned by a crank. During normal working of the machine, the feed clutch is operated by a lever, but when the feed is to be stopped at the end of a cycle, the clutch is disengaged by an electro-hydraulic system, operated by trip switches.

The spindle carrier is indexed by a Geneva mechanism, and is accurately located at each working position by two hydraulically-operated plungers. A separate Geneva mechanism is provided for indexing the bar feed unit, and can be disengaged independently if required, by turning a locking plate through an angle of 30 deg. With this arrangement, fresh bars can be loaded into the guide tubes while the

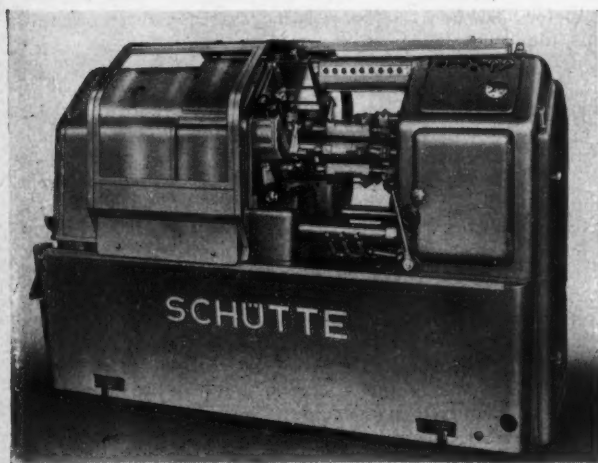


Fig. 1. Schütte type SE.16 6-spindle automatic

machine continues to run, and the locking plate then serves as an end stop. When loading has been completed, the machine is stopped and short pieces of the previous bars are removed from spindles. The locking plate is then returned to its original position to allow the fresh bars to be passed through the collets in the spindles. When the machine is to be set up for producing two components at each working cycle, an additional collet opening mechanism and a swing stop for the bar stock can be provided.

All important bearings and guiding surfaces are automatically lubricated by a pressure system, but when spindle speeds exceeding 3,000 r.p.m. are to be employed, an auxiliary pump unit can be supplied for delivering lubricant to the spindle bearings. Push-buttons and switches for controlling the working cycle are conveniently grouped at the front and rear of the housing for the feed mechanism, and pointers are fitted which are turned through a full circle at each revolution of the camshaft, and indicate, in conjunction with coloured scales, the portions of the complete cycle occupied by the individual movements. The machine stops in the event of faulty operation, and a coloured signal lamp is then lit. At the same time, one of a number of signal lamps mounted on an overarm between the spindle head and the housing for the feed mechanism is illuminated to indicate the location of the fault.

In addition to the cross-slide turning attachment, to which reference has already been made, the wide range of equipment for the machine includes a workpiece pick-off unit, also attachments for cutting threads with taps, button dies and self-opening die heads, thread chasing, reaming, high-speed drilling, deep hole drilling, milling, and cutting internal and external polygon shapes.

Fig. 2 is a close-up view of the machine set up for producing a component from brass bar in a cycle time of 3 sec., and the operations that are performed were described in *MACHINERY*, 96/38—6/1/60. In this view, the thread chasing attachment may be seen at A, mounted on the cross-slide at spindle position 5, and the cross-slide at the sixth spindle position carries a parting tool, also the swing stop B for the bar stock, which is fitted with a spade drill and a chamfering cutter. While the component is being cut from the bar by the parting tool, it is held in a collet incorporated in the pick-off attachment C, which is mounted on the carrier in place of one of the slides for an end-working tool, and is driven at the same speed as the spindles, namely, 4,000 r.p.m. Parting off completed, the pick-off unit is rapidly moved to the right, and the stop B is swung downwards to the position shown. The collet in the work spindle is

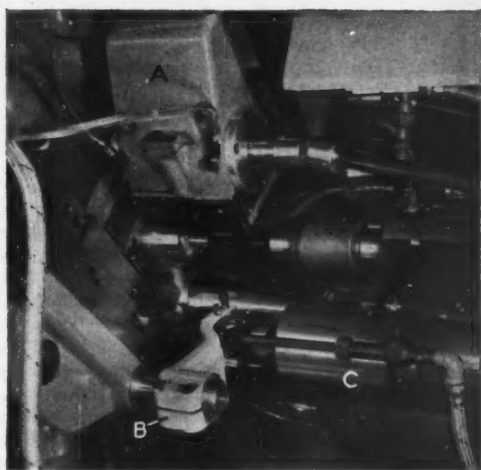


Fig. 2. Close-up view of the Schlütte type SE. 16 automatic fitted with a thread chasing attachment and a work pick-off unit

now opened to allow the bar to advance. At the same time, the attachment C is traversed to the left under feed, to bring the work into engagement with the cutting tools mounted on the stop B, for drilling and cutting internal and external chamfers on the rear end.

**DIAZOTHERM PHOTOCOPYING TECHNIQUE.** As a result of extensive research undertaken jointly by Copycat, Ltd., 40 Victoria Street, London, S.W.1, and Ets. Bauchet et Cie in France, a new photocopying process known as Diazotherm has been developed. The use of any chemicals for processing copies has been eliminated by the incorporation of new formulæ in the copy material, and by changes in coating technique. After exposure, as in the normal dyeline process, it is only necessary to apply heat. This heating will be carried out in the equipment as the material passes through the processing section.

The operator will only be required to feed the original and copy paper, and the processing will then be completed entirely automatically, including, with some types of equipment, automatic separation of the copy from the original, and automatic separate stacking of copies and originals. It is emphasized that all the advantages of the dyeline process will be retained, and that running costs will be somewhat reduced owing to the absence of chemicals.

## Milling Operations on a Single-spindle Automatic

SPACERS, OF THE DESIGN shown in Fig. 1, are employed in the assembly of the feed roll shafts for typewriters made by Underwood Business Machines, Ltd., Brighton. The spacers are made in a number of sizes, depending on the lengths of the carriages of the machines on which they are to be used, from seamless brass tubing of 0.187 in. outside diameter and 0.143 in. bore, limits of  $\pm 0.002$  in. being specified for both dimensions. As may be seen from the drawing, the spacer blank is a length of brass tubing with a slot 0.1 in. wide milled to a depth of 0.06 in. on each side. After the slots have been milled, the spacer is compressed, axially, with the result that its overall length is reduced by 0.03 in., and the bridges between the ends are pushed outwards. By compressing the bridges during assembly, with the aid of special pliers, the overall length of the spacer is increased to exactly that required.

These spacers, of which between 5 and 12 are required for each machine, are produced on the C.V.A. No. 8, single-spindle automatic shown in Fig. 2, which has been fitted with special milling attachments on the front and rear slides. Each attachment comprises a gearbox which is driven through a universally-jointed shaft by a separate electric motor mounted on a platform. Since the

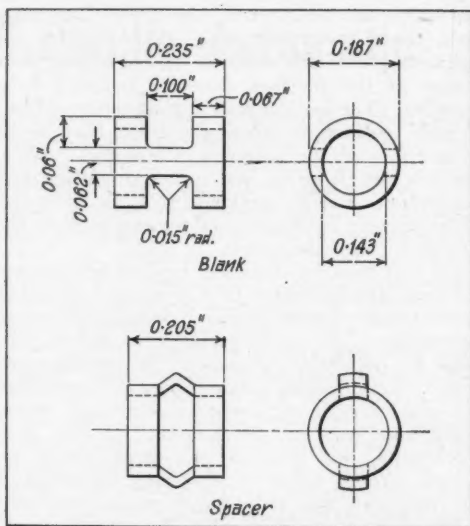


Fig. 1. Details of one of five sizes of spacers employed on the feed roll shafts of typewriters made by Underwood Business Machines, Ltd. It is produced by milling and compressing operations on a single-spindle automatic

photograph reproduced in Fig. 2 was taken, the position of the rear driving motor has been changed, in order to reduce the operating angle of the universal joint. The final shaft of each gearbox runs at 1,430 r.p.m., and carries a high-speed steel saw, of 40 mm. (1.57 in.) diameter by 0.100 in. thick, with 72 closely-pitched teeth.

During the machine cycle, which occupies 6 sec., the stock is first fed to a turret stop and the spindle is then braked for the milling operation, for

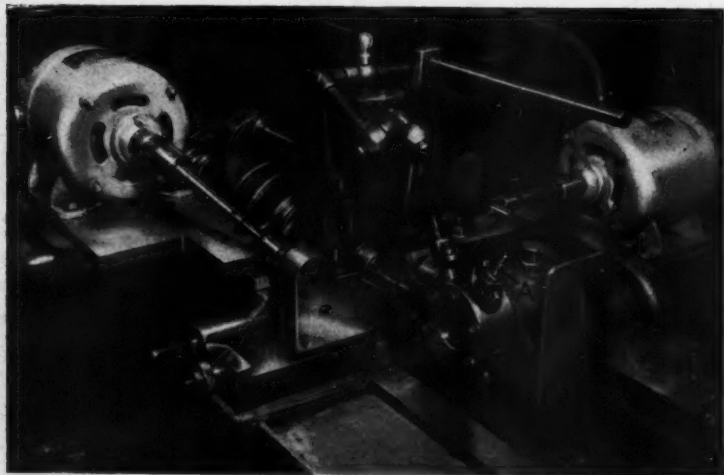


Fig. 2. At this set-up on a C.V.A. No. 8, single-spindle automatic, slots are milled in opposite sides of a brass tube which is then compressed axially, by the tool A, to form the spacer shown in Fig. 1

which the continuously-driven cutters are advanced simultaneously. A shell-type cutter in the turret is then fed over the tube to remove burrs thrown up by the slotting cutters, and is followed by a reamer which removes the internal burrs. Finally, the tool A is advanced until a shoulder comes into contact with the end face of the tube. Further movement of the tool then serves to compress the tube, the bridge-pieces between the slots being prevented from collapsing inwards by the spigot portion.

After the tool A has withdrawn, a cutting-off tool on a vertical slide above the spindle is fed downwards, to complete the cycle.

## Tape-spool Gripping Device

By G. G. HERZL

THE SPOOLS on which punched-paper and magnetic tape for use on machine tools are wound usually have bores of standard diameter, but the widths of the tapes, and consequently of the spools, often differs, depending on the programming requirements, or the system employed. Driving shafts for the spools must incorporate mountings which allow the spools to be rapidly removed and replaced, and means must be provided for gripping the bores of the spools with a predetermined and consistent pressure, to ensure that the drive is transmitted without slip.

In the figure is shown an arrangement for mounting spools of nominally-similar bore diameter, but different widths, which incorporates a gripping device whereby a consistent pressure is applied independently of the action of the operator. The periphery of the drum A is machined to suit the nominal bore diameter of the spools employed, and it has a flange at the left-hand end, to provide axial location for the spool. In the periphery of the drum there is a groove, which houses a square-section rubber ring B, and this groove passes through the outer ends of six, equally-spaced, drilled and counterbored radial holes. The drilled holes serve to house axially-sliding plungers C, and the outer end of each plunger abuts a steel ball in the counterbored portion of the hole.

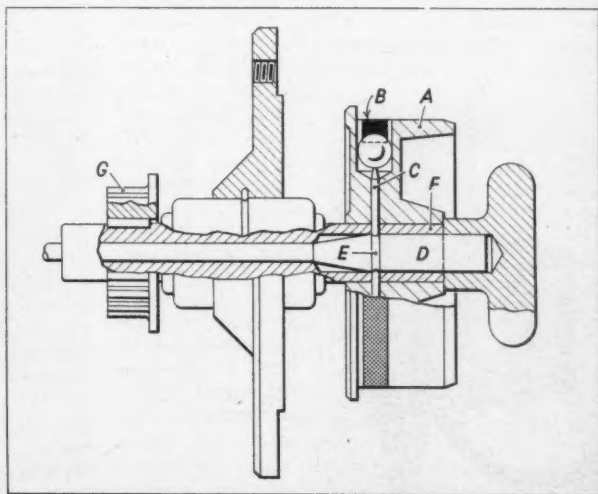
The inner ends of the plungers C pass through a sleeve member F and make contact with the periphery of the shaft D. This shaft is arranged

to move axially, within the sleeve F, being actuated by hand, or by a solenoid or some other suitable device, and incorporates a tapered portion, adjacent to the large end of which there is a round-bottomed annular groove, as at E. When the shaft D is moved fully to the left, as shown in the figure, the plungers C ride up the tapered portion until the inner ends engage with the groove E. As a result, the plungers are retained in the "expanded" position, and the shaft D is prevented from being moved accidentally in the axial direction. Positive drive between the sleeve F and the drum A is ensured by the presence of the plungers C, which serve as keys, to connect the two parts.

The outward movements of the plungers C impart similar movements to the steel balls, which are thrust against the bore of the rubber ring B. As the latter is expanded, it grips the bore of a tape spool which has been placed in position on the drum A.

When the tapered shaft D is withdrawn to the right, the plungers C slide down the tapered portion, the balls drop into the counterbores, the rubber ring contracts to its original size, and the tape spool is released.

The sleeve member F is driven by a timing-belt which engages the pulley G. The complete assembly is secured to the wall of the tape reader by the large-diameter flanged member seen at the centre in the figure.



An arrangement which provides for easily removing and replacing spools for punched-paper and magnetic tape, and for ensuring a friction drive of consistent value

## Commander Drilling and Tapping Equipment

THE RANGE OF DRILLING EQUIPMENT and tapping attachments made by the Commander Manufacturing Co., Chicago, U.S.A., is now being distributed in this country by Thoka Machinery Supplies, Ltd., 2 Drapers Gardens, London, E.C.2. Of the latter units, the smallest, which is known as the Midget tapper, provides for cutting threads up to 2 B.A. or 10-32 U.N.F. in steel. It can be supplied with a shank of  $\frac{1}{2}$ -in. diameter or with No. 1 or 2 Morse taper, and drive is taken through a pressure-sensitive clutch, whereby the torque transmitted is proportional to the feed pressure. Feed can be applied sensitively with this arrangement, it is stated, and the clutch will slip if the tap bottoms or encounters a hard spot in the work. Weighing 1 lb., the unit is  $1\frac{1}{2}$  in. diameter and  $3\frac{1}{2}$  in. long.

A similar drive arrangement is employed in the larger-capacity Standard attachment, and the range also includes the Pneu-Matic unit shown in Fig. 1, which can be used for cutting threads from 12 B.A. to  $\frac{1}{4}$ -16 U.N.F. Drive for this unit is taken from the drilling machine spindle, in the normal manner, and it incorporates a solenoid-operated air valve, which controls air cylinders for actuating the clutch and applying axial movement to the tapping spindle. The tapping cycle is started by means of a switch, that may be actuated by hand or foot or housed in the work fixture, and operation is fully-automatic for one complete sequence. Adjustment is provided for the tapping pressure and the length of stroke. A leadscrew assembly is available, which may be fitted in place of the normal spindle arrangement for



Fig. 1. Commander Pneu-Matic tapping attachment

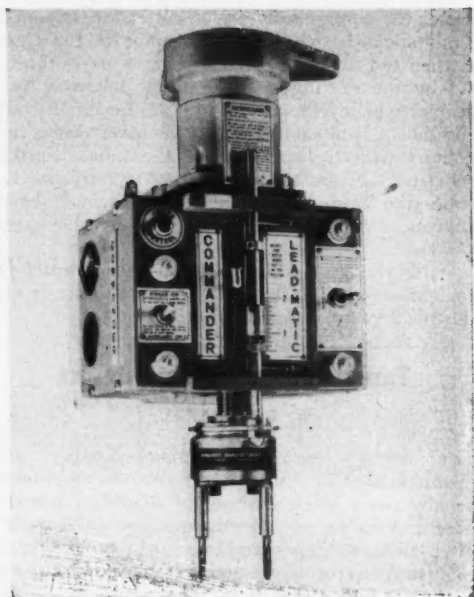


Fig. 2. Providing for pitch-controlled tapping in an automatic single cycle, the Commander Leadmatic attachment is here shown fitted with a No. 200, 2-spindle head

pitch-controlled tapping. Known as the Leadmatic, the attachment seen in Fig. 2 provides for pitch-controlled tapping. By means of a selector switch, it may be set for operation manually—when the tap is advanced and retracted by pressing and releasing a push-button—or in an automatic single cycle, which is started by this button or a remote switch.

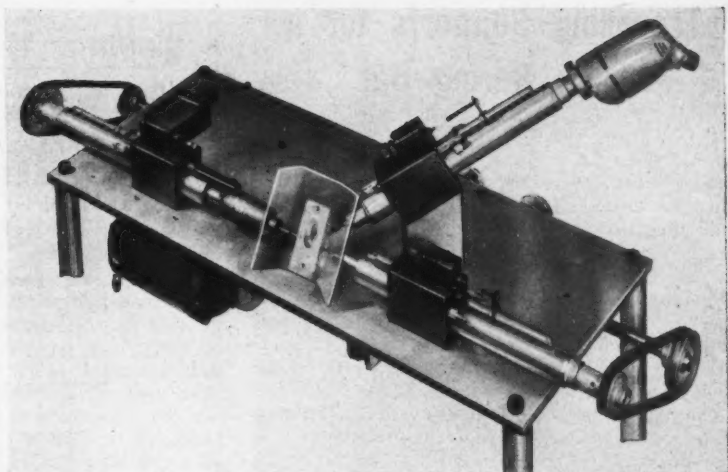
Referring again to Fig. 2, it will be seen that the attachment is equipped with a 2-spindle head. Designated No. 200, this head can also be mounted on the Standard and Pneu-Matic attachments, but is primarily intended for multiple drilling, the maximum capacity being  $\frac{1}{2}$  in. diameter in steel. The maximum and minimum distances obtainable between the spindle axes are 2 and  $\frac{1}{2}$  in. Drive is taken through heat treated gears, and the spindles run in plain bearings. If required, compensating systems can be fitted, for simultaneously tapping threads with different pitches. Alternatively, provision can be made for axial adjustment of the spindles with reference to scales graduated in divisions of 0.001 in.

The No. 600 Multi-Drill multiple drilling head shown in Fig. 3 has a capacity for drilling up to 4

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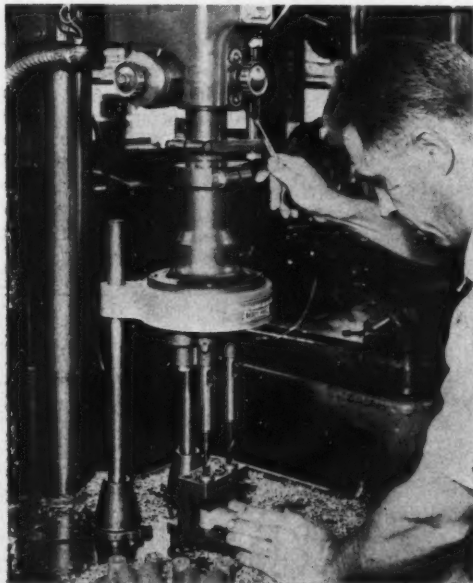
**Fig. 4.** This special-purpose set-up incorporates three type A Multi-Angle,  $\frac{1}{4}$ -in. capacity, drilling units



holes, of  $\frac{1}{8}$  in. diameter in steel, within an area of  $6\frac{1}{2}$  in. diameter. All the shafts are made from chromium - molybdenum steel and heat treated, and drive to the ball bearing - mounted spindles is taken through a speed reduction system. A unit is available for reversing the drilling machine motor, to enable the head to be used for multiple tapping operations, and vertical guide bar assemblies can also be supplied, as seen in the illustration.

Intended for incorporation in special-purpose set-ups, the type A Multi-Angle drilling unit has

capacity for holes up to  $\frac{1}{4}$  in. diameter in steel, and measures  $1\frac{1}{2}$  in. diameter by  $13\frac{1}{4}$  in. long. A double-acting air cylinder provides for the feed and return movements of the quill, and the maximum travel is 4 in. Drive for the spindle, which may be rotated at speeds up to 4,000 r.p.m., can be taken direct from an air or electric motor, or transmitted through a belt, or a flexible or universally-jointed shaft. A set-up incorporating three type A units is seen in Fig. 4.



**Fig. 3.** This No. 600 Multi-Drill head has a capacity for drilling up to 4 holes of  $\frac{1}{4}$ -in. diameter, in steel

**PLYWOOD CASES FOR BLACK & DECKER TOOLS.** It is reported that considerable savings in packaging and freight costs have been achieved by Black & Decker, Ltd., Harmondsworth, Middlesex, as a result of the adoption of standard plywood shipping containers for both home and export distribution. The containers are of the type 201, supplied by Venesta Plywood, Ltd., West Street, Erith, Kent, and the internal measurements of the seven sizes employed range from 36 by 20 by 16 in. to 43 by 30 $\frac{1}{2}$  by 22 in. These seven containers, it is stated, meet the requirements for all but one or two items from the extensive range of machines, tools, and accessories made by the company.

The containers are constructed from 6-mm. thick plywood, with metal reinforced edges, and among the advantages claimed is a substantial reduction in space required, as compared with the battened soft-wood cases previously employed. For one particular product, the overall space requirements for shipping have been reduced from 9.5 to 4.5 cu. ft.

## Travelling Supports for a Long Boring Bar

By H. B. SCHELL

BORING BARS for operations on barrels for large guns, for example, may often be as long as 70 ft., and must be supported at regularly-spaced positions in order to reduce sag to a minimum. As the bar is fed into the work, the supports should preferably close up, so that they remain equally spaced. A typical layout for a long boring bar, with three travelling supports, is shown in Fig. 1. The bar is driven, and fed into the work, by the head A, which is traversed by the screw B and the fixed nut C. Adjacent to the end of the work there is a fixed support member E, and the travelling supports are indicated at F, G and H.

For convenience, it is assumed that at the start of the operation the clear distances between E and F, F and G, G and H, and H and A, are equal. If the distances between the supports are to close up uniformly, then the support F must be traversed at one-quarter of the rate of advance of head A, support G at half the rate, and so on.

To fulfil these conditions, each support is provided with a gear casing, as at J Fig. 1, which is attached to the under-side and embraces the screw B. A view of a typical casing is shown in Fig. 2, where a portion of the screw B is shown and similarly lettered. Coaxial with the screw there are two gears, K and L. Gear L has a threaded bore, to suit the screw B, and serves as a traversing nut. Gear K, however, has a plain bore which is a running fit on the periphery of the screw B, and incorporates a key that engages with a keyway extending for the full length of the screw. The

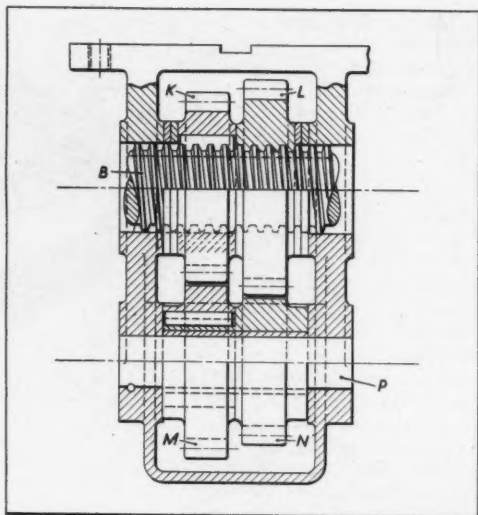


Fig. 2. Compound gearing provides for traversing each support member at the required speed relative to that of the boring head

gears K and L are free to rotate independently of each other, whereas the gears M and N are keyed together and are free to turn on the plain shaft P.

As the screw B rotates, drive is transmitted from the gear K to the gear M, thence by the gear N to the gear-nut L. It will be appreciated that with suitable ratios between the numbers of teeth on the gears K and M, and N and L, the latter can be driven around the rotating screw B to provide the required traverse speed of the support member relative to the speed of advance of the head A.

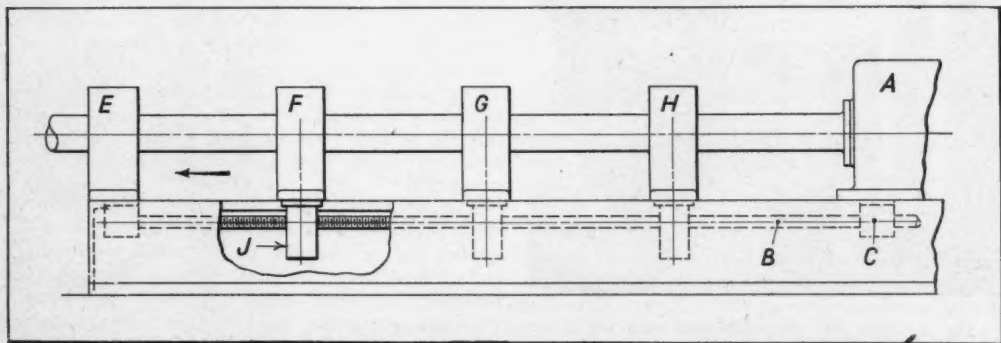


Fig. 1. Typical layout for a long boring bar with three travelling supports

## Automatic Cutter Grinding Head for the J & S Type 540 Surface Grinder

IN THE ACCOMPANYING FIG. 1, is shown a type 540 surface grinder, equipped with an automatic cutter grinding head which has recently been developed by A. A. Jones & Shipman, Ltd., Narborough Road, South, Leicester. As seen in the close-up view Fig. 2, the head is mounted on the table of the machine. The particular unit illustrated was specially designed to take gear shaper cutters with varying numbers of teeth and a fixed top rake of 5 deg. normal to the helix angle. Both left- and right-hand cutters can be accommodated. To reduce the load on the indexing mechanism, the driving shaft and cutter spindle are mounted in ball bearings. The bracket A in which the cutter spindle is carried can be swivelled through a maximum angle of 40 deg. on either side of the zero to suit right- or left-hand cutters, settings being made with reference to the scale at B. After adjustment, the bracket is rigidly locked with a hand lever.

For setting each cutter in position on the spindle, a locating piece is provided, as seen in the withdrawn position at C, and the cutter is locked by means of a central socket head screw.

Automatic indexing of the cutter spindle is derived from the reciprocating motion of the

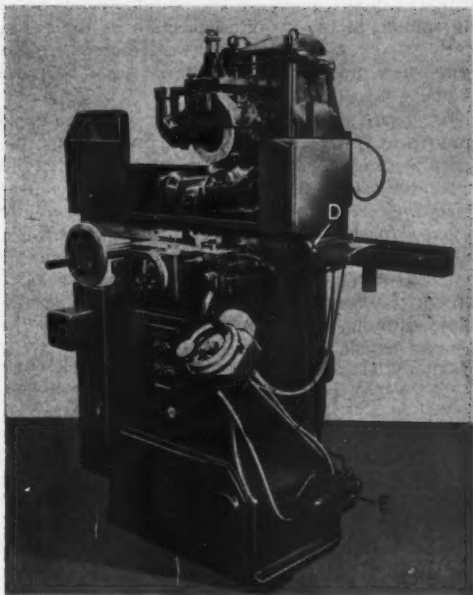


Fig. 1. Jones & Shipman type 540 surface grinder equipped with an automatic head for grinding shaping cutters for helical gears

machine table. For this purpose, a cam is mounted on the saddle at the rear of the table, and is engaged by a roller on a follower arm projecting from the head. Angular motion thus imparted to

the arm during the table stroke is transmitted through a pawl and ratchet mechanism and bevel gearing to the cutter spindle. With this arrangement, the angular motion of the arm is constant, since the roller traverses the complete cam profile at each stroke. The indexed positions of the spindle, however, are determined by accurately spaced notches in a disc secured to the lower ends. This disc is engaged by a spring-

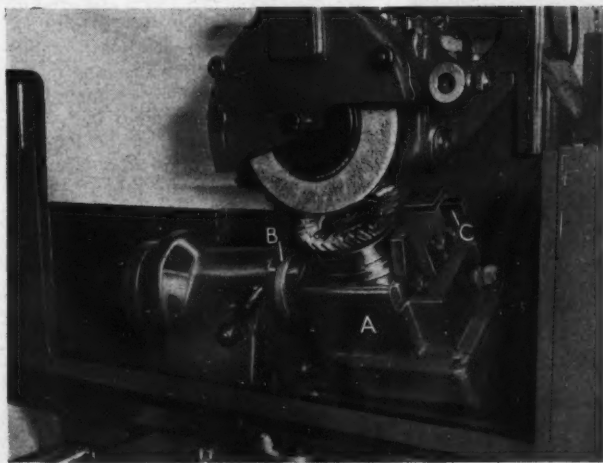


Fig. 2. A close-up view of the Jones & Shipman cutter grinding attachment. Indexing movements and down feed of the abrasive wheel are applied automatically during the grinding cycle

loaded V-point lever which automatically locks the spindle in the required position as the cutter tooth passes under the wheel. Interchangeable discs are provided for cutters with different numbers of teeth.

To ensure stability when cutter grinding is in progress, a special lock has been provided for the machine saddle. It may also be noted that an adjustable safety stop has been fitted, as seen at *D* in Fig. 1. Should the table be accidentally traversed past the reversing dog, this stop ensures that the teeth on the opposite side of the cutter cannot foul the 8-in. diameter grinding wheel.

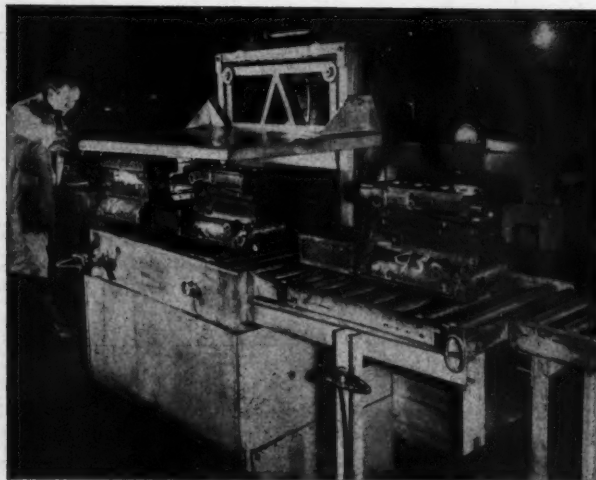
After the completion of each revolution of the cutter spindle, a limit switch is operated to energize a solenoid operated valve *E*, Fig. 1, in

the down feed hydraulic circuit. As a result, a predetermined feed increment is automatically applied, and this action is repeated until further feed is prevented by an adjustable trip mechanism on the column. After down-feed has ceased, the wheel is allowed to spark out, and the table traverse is then stopped manually.

The automatic down-feed unit provided on the machine has been modified by the incorporation of a special screw and worm gearing, to give down feeds from 0.0003 to 0.0015 in. instead of the normal range from 0.0001 to 0.0005 in. With this arrangement, one revolution of the handwheel imparts a feed of 0.06 in., as compared with 0.02 in. for the standard unit.

## Dawson "Dunking" Machine for Cleaning Metal Workpieces

Dawson Bros., Ltd., Gomersal, near Leeds, for whom the sole agents are Drummond-Asquith, Ltd., King Edward House, New Street, Birmingham, 2, have recently added to their range of metal cleaning and de-greasing equipment a "dunking" machine, which provides for treatment of the work by immersion and agitation. Typical applications for the new machine include the rough cleaning of cylinder blocks for internal combustion engines, and washing sand from castings.



With this Dawson "dunking" machine, contaminants are removed by reciprocating the work vertically while it is immersed in the cleaning fluid

An air operated table of slat-type design is provided, which is lowered to immerse the work in the cleaning fluid. At the end of this movement, the table is automatically reciprocated in the vertical direction. This motion causes a strong turbulence in the fluid, which assists in the removal of contaminants from work surfaces and recesses. The table is raised at the end of the cleaning period, in readiness for unloading. If required, continuous filtering equipment can be incorporated.

The example shown in the accompanying illustration is one of nine machines installed in the works of F. Perkins, Ltd., Peterborough, for cleaning cylinder blocks, heads, and other engine components, and is arranged in a conveyerized line. Work is transferred manually from the incoming roller conveyor to the machine table, and the cleaning cycle is initiated by means of a hand-operated air valve. This valve is returned to the original setting at the end of the cleaning period, for raising the table. Subsequently, when the next batch of soiled parts is loaded, the finished work is discharged at the opposite end of the machine.

Duplex units can be supplied which provide for washing and rinsing, for example. The design is such, moreover, that any number of machines may be arranged in line and linked by transfer equipment where more complex processing is required.

# Machine Tool Statistics

## Value and Pitfalls of Published Figures

At first sight, the machine tool industry would appear to be a well-documented trade from the point of view of statistics, both governmental and otherwise, and it is only after prolonged study that the investigator begins to realise that it is not every published figure or table which can be accepted at face value, especially when it is to make international comparisons.

One of the first points to be borne in mind is that a machine tool is differently defined in different countries. In Canada, for instance, rolling mills and similar plant are regarded as falling within this category, which may on occasion affect the total to the extent of 20 per cent; in Denmark, foundry, wood, and stone-working machines are included; Swiss official returns embrace wood-working machinery; and so on. Moreover, many of the figures reported from time to time in the press of various countries, and even by official organizations, are misleading.

Most readers will be acquainted with the fact that for several years past an active campaign has been in progress in the United States urging higher tariffs to keep out foreign machine tools—in spite of the fact that until the last year or so such imports have been quite insignificant compared with the volume of domestic production (3 to 5 per cent in 1957/8). In support of this campaign, an American machine-tool publication recently gave warning that an increase in such imports was to be expected, and that they "already accounted for 30 per cent of domestic sales". Two months later a French trade paper in the same industry reported that it was estimated 35 to 40 per cent of American purchases of machine tools were of foreign origin. The explanation subsequently given for this statement was that a decimal point had been omitted between the figures. An English engineering publication, in a comparison of Italian production with that of various West-European countries, made an error of 50 per cent in the output of that country, and subsequent investigation showed that the contributor, in this instance, had selected the figure for an entirely different year from that to which the remainder related. A table of British machine-tool exports published in a German technical journal in which none of the figures bore the slightest resemblance to reality was later explained

as being due to the contributor having mistaken dollars for £ sterling.

Even Government departments are not altogether above reproach in this respect, as was borne out by a complaint some years ago that official figures for machines built during the period 1941-1942 were incorrect to the extent of more than 40 per cent for lack of a clear definition of a machine tool.

There has just been published in France an important work by Monsieur A. A. Garanger\*, the Director General of the French Machine Tool Builders' Association, dealing with the past history and the present development of the industry in all the main manufacturing countries, the work being divided into three stages, the last of which brings the survey up to the end of 1960. Among the 288 pages of text there are interspersed numerous tables showing development, country by country, in respect of labour employed, total production, exports, and imports, the figures, as far as can be judged, being remarkable for their accuracy. Throughout the book a considerable amount of information is also given as regards the age of the machine tools in operation in various countries, although a considerable proportion of such data appears to be based on private and partial surveys rather than census figures, and some seems to rest merely upon unsupported assertion. In connection with the information relating to the average age of French machines in service, the author admits that in the past the picture seems to have been painted in too dark colours, this evidently having been done "for the good of the cause".

From the point of view of the foreign reader, whereas the tables of statistics are numerous and accurate, the comparison of results in one country with those of another entails a considerable amount of work because the values, in nearly all cases quoted, are in the currency of the country under review. In consequence, frequent reference to past and present exchange rates is necessary. This drawback is particularly noticeable in connection with the French statistics, as it will be remembered that the international value of the

\* *Petite Histoire d'une Grande Industrie* (by André A. Garanger) published by the Société d'Édition pour la Mécanique et la Machine-Outil, 150 Bd. Bineau, Neuilly-sur-Seine, (Seine), 288 pages, 104 x 74". Price (abroad) registered NF 54.

franc, which was 25 to the £ in 1914, declined to 85 in 1924, 105 in 1936, 178 in 1938, and 1,178 in 1958, and that the present-day rate is 13.7 NF to the £. Any investigation of the French situation is therefore somewhat similar to an attempt to obtain the dimensions of a building by using an elastic rule.

Another point of criticism is that the author has relied somewhat extensively upon figures published in the trade press of various countries rather than upon the basic government statistics, some of the pitfalls of the former course having already been mentioned. It is only fair to say, however, that Monsieur Garanger has not been misled by the American campaign on the subject of imported machines, and he correctly reports these as being in the neighbourhood of 2½ per cent during recent years.

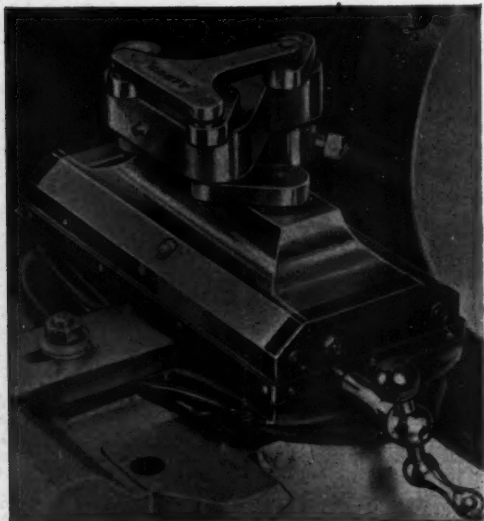
In the tables which are given for the production and exports of communist countries, the author has perforce had to follow the official policy of those countries in merely quoting numbers of machines produced with no indication of weight

or value. Under this system a small bench drill counts as one machine equally with a large planer weighing 50 tons, so that for practical purposes the information given is valueless. In the case of Poland, however, the author quotes on page 215 some interesting figures regarding the weight of production for several years, these data having hitherto been unprocurable from any official source. A footnote states that these were taken from *Machines and Tooling*, a publication which may be better known to some of our readers by the Russian name of *Stanki i Instrument*. In this connection it may be appropriate to observe that the present reviewer, who was particularly interested in this new item of information at the time when it was originally published in the Soviet journal, endeavoured to obtain from the editor some indication of the source of the figures with a view to forming an opinion on their probable authenticity, as well as some information about the contributor. All enquiries on the subject, however, were entirely without result!

A. J. G. S.

## Habit Tally-Form Diamond Dressing Device

Habit Diamond Tooling, Ltd., Lurgan Avenue, London, W.6, have introduced the Tally-Form diamond dressing device, here illustrated, for producing an accurate radius on one or both corners of a grinding wheel of any diameter, which are truly tangential to the peripheral surface. The dressing



operation is performed in one continuous movement, to ensure that the radii are correctly blended with the straight face, with no witness lines at the points of transition.

Movement of the slide is obtained by means of a handle and screw, and the radius dressing motion, which is controlled by means of adjustable stops, is imparted to the diamond holder through a double linkage arrangement. The maximum slide travel for combined radius and peripheral dressing is 1½ in., and convex radii up to 1½ in., and concave radii up to 1 in. can be produced. A flexible cover protects the slide against the ingress of abrasive dust.

For dressing wider grinding wheels, the radiusing mechanism can be supplied as a separate unit, the machine table movement then being employed for truing the wheel periphery. The units are of compact design and are suitable for use on all types of cylindrical, tool and cutter, and surface grinding machines. Overall dimensions of the combined peripheral and radius dressing device are 10½ in. long by 4 in. wide by 5½ in. high, and of the radiusing unit only, 5 in. by 4 in. by 4½ in. high.

Habit Tally-Form combined peripheral and radius diamond dressing device

## Winstan Die Sets and Guide Pins and Bushes

THE WINSTAN RANGE OF PRODUCTS made by Winstanley & Co. (Kings Norton), Ltd., Trading Estate, Pershore, Worcs., covers die sets in steel and cast iron, also guide pins, and bushes of the plain and bearing ball types.

Cast iron die sets in the range are available in rectangular form with rear-mounted guide pins, "long rectangular" and square, with pins positioned at the rear or diagonally, and circular, with the pins at the rear or on the centre line of the die space. With the rectangular types, the length of the die space in relation to the width is in the ratio of 4 to 3, and the range covers 15 sizes from 3 by 2½ up to 24 by 18 in. The length of the die space in relation to the width in the "long rectangular" die sets is in the ratio of 2 to 1, and 13 sizes are available from 5 by 2½ up to 24 by 12 in. Other sets in the range have die spaces from 3 by 3 to 21 by 21 in., and from 3 to 21 in. diameter. The thickness of the bolster and top plate varies from 1 to 2½ in. for die sets in the standard range, depending upon the size, but heavy-duty types are available, which have thicknesses from 1½ to 3 in.

Steel die sets can be supplied in rectangular, "long rectangular" and square types, with two guide pins which can be positioned at the rear, diagonally, or at the ends of the die space on the centre line. They have die spaces up to 24 in. long, and can be supplied with a length to width ratio of 5 to 3 or 4 to 3 for the rectangular, and 5 to 2 or 2 to 1 for the "long rectangular" types. Die sets in steel and cast iron, which have four guide pins, have recently been added to the range. These sets are available with die spaces from 3 to 24 in. long, and have length to width ratios of 4 to 3, 2 to 1 and 1 to 1. On the left in Fig. 1 is shown a steel die set, and on the right a cast-iron die set, with two rear-mounted pins, from the company's range.

Plain guide pins and bushes in the Winstan range are made from steel case hardened to 60 to 62 Rockwell C, and the pins can be supplied in diameters from ¾ to 2½ in., and lengths from 3¾ to 9 in. The portions which are intended to be pressed into the die sets are ¾ to 2½ in. long on the guide pins, and from ¾ to 2½ in. long on the bushes. A threaded

hole is provided in the upper end of each guide pin to take a lifting hook for instance, or for the attachment of a keep plate when the press tool and die set assembly is to be stored or transported.

Ball-type guide bushes are made in two designs, in one of which the cage for the bearing balls slides within the body and in relation to the guide pin when the press tool is in operation. The maximum sliding movement is controlled by a cross screw in the body which engages with a slot machined in the cage parallel with the centre line. Bushes of this type are available in standard and heavy-duty designs for use with press tools which have fairly short working strokes.

With the second type, which is intended for operation in conjunction with press tools with long working strokes, a stationary ball cage is mounted in the bore of the bush at either end. Bushes of this type are available in lengths from 1 to 6 in., and, if required, such a bush may be brought out of engagement with the end of the guide pin during the upward travel of the ram on the press. Bushes of both types can be supplied to suit guide pins from ¾ to 3 in. diameter in ¼ in. steps up to 2½ in. diameter, and ¼ in. steps for larger sizes. Each bush is precision ground at one end to a push fit in a bore in the top plate of the die set, and is supplied with a separate ring, drilled to take fixing screws, which engages with an enlarged-diameter taper portion at the periphery, to form a flange.

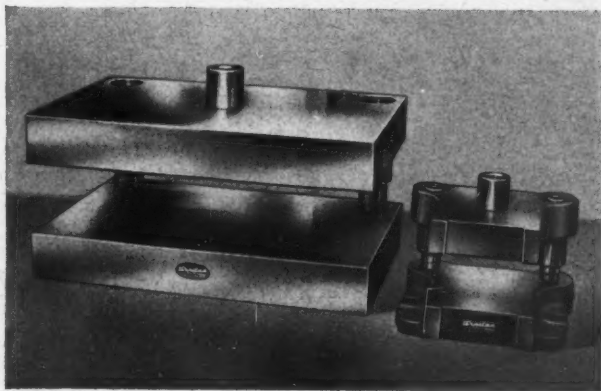


Fig. 1. (left) A steel die set and (right) a cast iron die set from the Winstan range

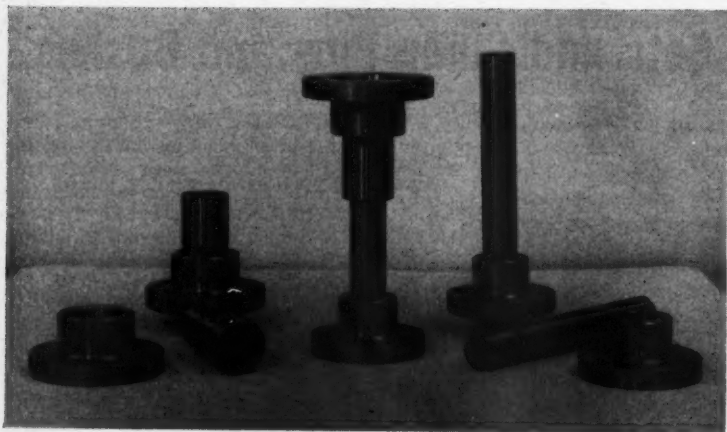


Fig. 2. Some examples from the Winstan range of detachable guide pins and bushes for die sets

The bushes and the mating guide pins are made from oil-hardening tool steel.

In Fig. 2 are shown examples from the company's range of detachable guide pins and bushes for die sets. A portion of the guide pin in one of these assemblies is a press fit in the bore of a flanged bush, termed a shoe, which is secured to the bolster on the die set by means of screws. The upper end

of the pin is a sliding fit in a hardened steel guide bush which is pressed into the bore of a second "shoe," the latter being attached to the top plate of the die set, again by screws. When the assemblies have been secured in the required position, holes can be drilled in the flanges of the "shoes" and in the bolster and top plate to take dowel pins. With this arrangement, the need for boring holes in the bolster and the top plate to take guide pins and bushes is avoided. Another feature of the design is that the entire

assembly can be quickly removed from the die set, and grinding of the top face of the die and the ends of punches can then be carried out without interference. The guide pins are available in diameters from 1 to 2 in. in  $\frac{1}{4}$  in. steps, and if required a flanged bush of the ball type can be provided in place of the upper "shoe" and bush assembly.

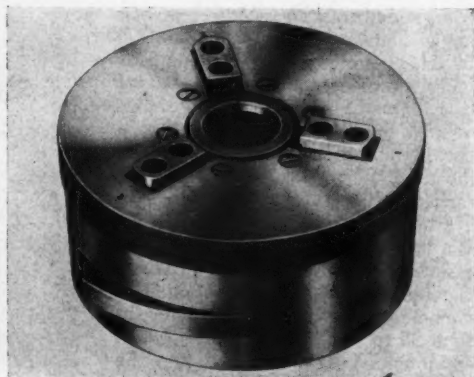
### Espey Automatic 3-jaw Chuck

In the illustration is shown an automatic 3-jaw chuck for a lathe, which has been introduced by Gustav Espey, G.m.b.H., 102 Musfeldstrasse, Duisburg, Germany.

The jaws can be moved inwards to grip the work lightly by turning a knurled end plate on the body, and the clamping pressure is automatically increased when the chuck is rotated and a cut is applied. With this arrangement, workpieces can be quickly loaded into the chuck, and since the gripping pressure varies with the cutting force, the risk of damaging and de-forming soft metal components is avoided. On the other hand, a powerful clamping force can be obtained when heavy cuts are being taken on parts of steel and cast iron.

A latch, which normally extends from the body, is depressed when the clamping pressure is to be released, and this can be done while the chuck is rotating, if required, by means of a pivoted arm attachment mounted on the bed of the lathe. The chuck is available in three sizes which have body

diameters of 3-9, 7 $\frac{1}{2}$ , and 9-9 in., and lengths of 2 $\frac{1}{2}$ , 3 $\frac{1}{2}$ , and 3 $\frac{1}{2}$  in. They will take workpieces with diameters ranging from  $\frac{1}{4}$  to 2 $\frac{1}{2}$ , 2 to 5, and 2 $\frac{1}{2}$  to 7 $\frac{1}{2}$  in.



Espey automatic 3-jaw chuck which provides automatic adjustment of gripping pressure

## NEWS OF THE INDUSTRY

### **The South West**

**BRISTOL TOOL & GAUGE CO., LTD.**, Church Road, Kingswood, Bristol, are exceptionally busy with orders for special purpose machines, press tools and Bristol-Erickson rotary indexing tables. The design office facilities for special purpose machine projects have been increased.

**TELEHOIST, LTD.**, Manor Road, Cheltenham, Glos., are as busy as ever with orders for hydraulic equipment for commercial vehicle applications and for use in industry. Many different types of vehicles for road transport and civil engineering work are now fitted with Telehoist tipping gear designed for operation under severe conditions. The No. 2 factory, also at Cheltenham, has an area of approximately 18,000 sq. ft., and is equipped with a wide variety of new machine tools for the production of hydraulic valves, pumps and motors for industrial applications. A portable power-pack unit comprising a hydraulic pump, electric driving motor, oil reservoir and control equipment, designed and built by the company, is reported to be in increasing demand from various industries.

**BRISTOL PIPING CO., LTD.**, Bedminster, Bristol, are still busy with the production of an interesting variety of piping assemblies incorporating large- and small-bore pipes of various wall thicknesses. This company is increasing facilities for the cutting and manipulation of steel plate and the production of weld-fabricated structures in steel.

**WESTERN DIECASTING, LTD.**, Barton Hill, Bristol, 5, are currently occupied with the production of a variety of hardware parts of weights ranging up to 12 lb., in Mazak alloys. An additional shop has been acquired, and the equipment installed includes two Schultz die casting machines, the larger of which is arranged for operation on an automatic cycle. Both machines are at present fully

employed with the production of the larger castings on order. A Hare long-stroke hydraulic press has been added to the flash-trimming line, and a Slack & Parr 6-spindle drilling machine has lately been acquired. Facilities for die machining have been improved by the installation of a Deckel type KF die sinking machine in the tool-room.

**P. J. HARE, LTD.**, Wrington, Somerset, have recently extended the productive floor space at their works by approximately one-third, and as a result of the improved facilities thus provided it has been possible to double the rate at which Hare hydraulic presses and indexing tables are produced. The 5-ton bench press and integral indexing table which the company introduced two years ago is stated to have proved very popular. This table is designed to provide smooth movement between stations which may number 4 or 8 according to users' requirements. Tables suitable for operating speeds up to a maximum of 60 indexing move-



Hare 5-ton hydraulic press with integral 4-station indexing table, set up for assembling steel cores and brass liners at the works of Allen West, Ltd., Brighton

ments per minute may readily be attached to or removed from the base, as required. This feature enables tool-up tables to be quickly interchanged for short production runs.

A typical application of this type of press is seen in the illustration, which shows part of a production line at the works of Allen West, Ltd., Brighton, Sussex. The 4-station indexing table is equipped with tooling for swaging steel cores in brass liners, and it is stated that output has risen and that the percentage of rejects has fallen sharply since this machine was installed.

G.I.B. PRECISION, Barton Lane, Cirencester, Glos., are still busy with orders for sub-contract machining for a number of engineering firms. During the past year, capacity for general machining and repetition work has been increased by the installation of additional machine tools, including two Fostermatic single spindle automatics.

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The illustration shows a 29-ft. long Beaver ball screw which was supplied by Bristol Siddeley Engines, Ltd., Parkside Works, P.O. Box 17, Coventry, for the Hinkley Point atomic power station. It is stated that screws of this type have been made by the company for a very wide range of applications, with lengths from 2 in. to 29 ft. 6 in. and pitch diameters up to 6 in. for operation under loads up to 370,000 lb. (825,000 lb. static). Various materials are employed, including stainless steels, and screws can be supplied to run unlubricated at high temperatures. A lead accuracy of 0.0002 in. per ft. is maintained



DELAPENA & SON, LTD., Cheltenham, Glos., report a sustained level of orders for vertical and horizontal type honing machines, also induction heating equipment. Export orders and enquiries for gear tooth hardening equipment are stated to be very satisfactory. We are informed that one of the largest r.f. heating installations yet built by this company, which is rated at 75-100 kW., has been sold to a firm in Switzerland.

R.F. COMPONENTS (CHELTENHAM), LTD., Lansdown Place Lane, Cheltenham, Glos., have made steady progress in the application of electro-erosion methods of machining to the production of a wide variety of parts in tungsten-carbide and hardened alloy steels. Such parts are frequently required to have apertures or deep cavities to close tolerances. Recently, for example, Sparcatron equipment was used to produce a hole of rectangular section, in a curved path, to a depth of 1½ in. in a heat treated core for a plastics mould. Work is in progress in the machine shop on a variety of components, some of which are required for prototype equipment.

New machine tools installed here during recent months include a Myford lathe with a Mini-Kop copying attachment, two Willson centre lathes, and a Kneller multi-purpose lathe which is provided with attachments which enable various operations to be performed in addition to normal centre lathe turning. It may also be noted that an additional Sparcatron machine has been acquired.

F. W. HERRIDGE.

### **Mitsui Jig Borer Developments**

Following their participation at the Moscow Trade Fair in August last year, the Mitsui Precision Machinery & Engineering Co., Ltd., received orders from Russia for three No. 0 and twenty No. 3 size jig borers. Ten of the machines, which were described in **MACHINERY**, 96/1218—1/6/60 and 98/412—22/2/61, have now been delivered, and we are informed that a further order has since been received for four No. 0 and eight No. 3 machines.

Due to delay in obtaining the bed casting, it will not be possible for the company to exhibit the production version of their Jidic 7 tape-controlled jig borer at the Tokyo International Trade Fair this year, as forecast in the second of the articles referred to above. Both this machine and the new No. 5 are now scheduled for completion by August next.

The company has completed the design and construction of a new measuring machine for lead-screws up to 3.9 in. diameter by 19.68 ft. long, with

a maximum lead of 2 in., and a minimum pitch of 0.078 in. This machine incorporates an automatic recording unit which enables continuous measurements to be made rapidly, also a detector unit to eliminate the effects of errors in the measuring screw and other parts. Index errors of multi-start threads can be measured, and provision is made for remote indication of the results obtained.

On page 411 of the second article mentioned above, it was incorrectly stated that the company employs standard scales supplied by Hilger & Watts, Ltd., in their jig boring machines. In fact, the company engraves the scales which are then checked by reference to a standard scale made by the British company and certified by the National Physical Laboratory.

### M.T.T.A. Officers and Committee

The Officers, Council and Committee of the Machine Tool Trades Association for 1961-1962 are as follows: President, J. C. Snow; Vice-President, J. P. Hunt; Hon. Treasurer, A. Graham Dowding.

**COUNCIL** (*Ex-officio members*): J. C. Snow, J. P. Hunt, A. Graham Dowding, and the following past presidents: Sir Greville S. Maginness, K.B.E., Sir Lionel Kearns, C.B.E., J. B. S. Gabriel, Robert W. Asquith, R. D. G. Ryder, H. P. Potts, J. C. Robinson, and E. W. Field, O.B.E.; also C. G. Twallin, C.B.E., and G. E. Hickman (past hon. treasurers). *Elected by the Machine Tool Manufacturers' Section*: B. E. Cash, Col. C. W. Clark, D.S.O., O.B.E., M.C., A. J. Hayward, H. J. D. Kearns, and A. E. Pollard (retiring 1962), J. W. Butler, J. E. Hill, W. V. Hodgson, R. H. Orcutt, and F. E. Wand (retiring 1963), J. P. Hunt, J. C. Petter, D. S. Player, E. Town, and E. Williams (retiring 1964). *Elected by the Machine Tool and Small Tool Importers' Section*: D. W. Cooper, G. W. H. Nash, and S. W. Perkins (retiring 1962), P. Catmur, H. A. Chambers, and H. Vernon (retiring 1963), W. Core, W. G. Hunt, and T. N. Woof, M.C. (retiring 1964). *Elected by the Woodworking Machinery Manufacturers' Section*: C. H. Morris (retiring 1962), M. A. White (retiring 1963), and A. H. Spindler (retiring 1964). *Elected by the Allied Trades' Section*: G. Balfour (retiring 1962), R. P. Britton (retiring 1963), A. W. Lee and P. Neill (retiring 1964).

**EXECUTIVE COMMITTEE**: J. C. Snow, J. P. Hunt, A. Graham Dowding, Sir Greville S. Maginness, K.B.E., Sir Lionel Kearns, C.B.E., J. B. S. Gabriel, Robert W. Asquith, R. D. G. Ryder, H. P. Potts, J. C. Robinson, E. W. Field, O.B.E., C. G. Twallin, C.B.E., G. E. Hickman, J. C. Petter, T. N. Woof, M.C., C. H. Morris, P. Neill, Col. C. W.

Clark, D.S.O., O.B.E., M.C., and G. W. H. Nash.

**MACHINE TOOL MANUFACTURERS' SECTION COMMITTEE** (*Elected members*): J. G. Petter (chairman), Col. C. W. Clark, D.S.O., O.B.E., M.C., H. J. D. Kearns, D. S. Player, and J. C. Snow. (*Ex-officio members*): Robert W. Asquith, E. W. Field, O.B.E., J. P. Hunt, Sir Lionel Kearns, C.B.E., Sir Greville S. Maginness, K.B.E., and R. D. G. Ryder.

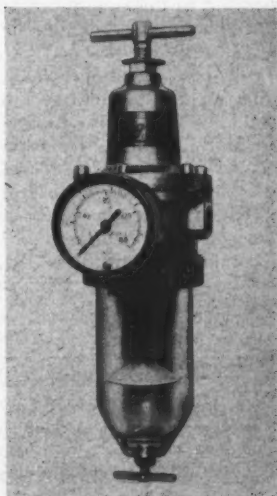
**MACHINE TOOL AND SMALL TOOL IMPORTERS' SECTION COMMITTEE** (*Elected members*): T. N. Woof, M.C. (chairman), P. Catmur, H. A. Chambers, L. J. Hugo, and G. W. H. Nash. (*Ex-officio members*): E. W. Field, O.B.E., J. B. S. Gabriel, J. P. Hunt, and J. C. Snow.

**WOODWORKING MACHINERY MANUFACTURERS' SECTION COMMITTEE** (*Elected members*): C. H. Morris (chairman), P. Brookman, H. Clayton, G. R. Pickles, and M. A. White. (*Ex-officio members*): E. W. Field, O.B.E., J. P. Hunt, J. C. Robinson, and J. C. Snow.

**ALLIED TRADES' SECTION COMMITTEE** (*Elected members*): P. Neill (chairman), G. Balfour, R. P. Britton, C. F. Hurst, and A. W. Lee. (*Ex-officio members*): E. W. Field, O.B.E., J. P. Hunt, and J. C. Snow.

### Norgren Combined Filter-regulator Units

The illustration shows one of the series 73AC combined filter-regulator units which have been introduced by C. A. Norgren, Ltd., Shipston-on-Stour, Warwicks., these units being based on the Norgren series 30AF filters and 20AG regulators. Units are available with bowls of transparent plastics or metal, and with the former type of bowl, are suitable for use with air and non-corrosive gases at pressures up to 150 lb. per sq. in. and temperatures up to 120 deg. F. When a metal bowl is supplied, the maximum permissible pressure is 250 lb.



Combined filter-regulator unit from the recently-introduced Norgren series 73AC range

per sq. in., and the maximum temperature, 200 deg. F. A wide range of regulating springs is available, and a compound spring to provide for a delivery pressure from 0 to 125 lb. per sq. in. is normally supplied. The standard filter element is a 64 micron sintered bronze type. Alternative sintered bronze elements of 5, 10 and 25 micron size can be provided, and a 74 micron (200 mesh) Monel screen element is also available.

Units can be supplied with connections tapped  $\frac{1}{4}$  or  $\frac{1}{2}$  in. B.S.P., and with pressure regulator valves of the relieving or non-relieving type. All units are available without pressure gauges, if desired. The regulating valve is of the balanced design, with Norgren baffle and siphon tube arrangements to ensure that the output has good flow and regulation characteristics.

Air first enters the filter section, where a deflector imparts a swirling motion. The heavier dirt particles and liquids are thus removed by centrifugal action and fall to the bottom of the bowl. A "quiet zone" in the lower half of the bowl retains the contaminants and prevents their return to the air stream. Air then passes through the filter element to the regulator assembly, and thence to the outlet port.

## The Importance of the Plasma Jet

(Continued from page 807)

spraying in thicknesses from a few thousandths to  $\frac{1}{2}$  in., on metals, graphite, and some special grades of heat-resistant plastics.

For component production, material may be built up to the required thickness on a metal mandrel which is subsequently removed by chemical action. Tungsten parts made in this manner have included rocket nozzle liners, tubes, crucibles, and electronic grid cages.

Evidently the plasma jet has many potentialities, some of which will assume increasing importance in connection with the wider application of various metals and materials that cannot readily be processed in other ways.

## Personal

MR. JOHN MARSH has accepted an invitation to become director of the British Institute of Management, 80 Fetter Lane, London, E.C.4, from October 1. Since 1950 he has been director of the Industrial Welfare Society.

MR. E. C. RIPPON has been co-opted as a director of C. A. Parsons & Co., Ltd., Heaton Works, Newcastle-upon-Tyne, 6. He was formerly chief transformer engineer, and during the past year has been concerned with the organization of design and production throughout the works.

MR. C. C. BRITTON has joined the board of W. E. Norton (Machine Tools), Ltd., Grosvenor Gardens House, Grosvenor Gardens, London, S.W.1. In addition to his managerial duties he will continue to represent the company in parts of the South of England.

MR. JAMES R. BEARD, C.B.E., will be the next president of the Electrical Research Association, Thorncroft Manor, Dorking Road, Leatherhead, Surrey. A senior partner in Merz & McLellan, he is known internationally for his work in the electrical field.

MR. OSCAR FREY has relinquished his post as managing director of Anglo-Swiss Screw Co., Ltd., West Drayton, Middlesex, after 41 years' service since he founded the company. He remains chairman of the board, with Mr. P. R. Brierley and Mr. F. A. H. Frey as joint managing directors.

MR. E. J. HUNTER, chairman of Swan, Hunter & Wigham Richardson, Ltd., Mr. J. R. EDWARDS, managing director of Pressed Steel Co., Ltd., and the HON. GEOFFREY ROOTES, deputy chairman and managing director of Humber, Ltd., have been elected vice-presidents of the Institution of Works Managers, 196 Shaftesbury Avenue, London, W.C.2.

## Columbus-Dixon Cleaning Equipment

A permanent exhibition of the industrial floor-maintenance machines made by Columbus-Dixon, Ltd., Empire Way, Wembley, Middlesex, has been opened by the company in their London showrooms at the Quadrant Arcade, 80 Regent Street, W.1.

The range of equipment on view includes machines and attachments for suction cleaning; scouring; scraping; washing; wet and dry scrubbing; drying; and, if necessary, polishing, factory and office flooring. Some of the machines on view can be also fitted with attachments for grinding and sanding concrete surfaces.

## Books Received

THE MACHINING OF STEEL. By F. C. Lea, D.Sc., M.I.C.E., M.I.Mech.E., and E. N. Simons. Odhams Press, Ltd., 96 Long Acre, London, W.C.2. 208 pp. [Price 21s. 0d. net.]

Fundamental practical principles of cutting and shaping plain and alloy steels are here presented, together with information on the machines and methods used. Chapters are devoted to turning, planing, shaping, milling, drilling, broaching, reaming, and sawing, and the book should prove a useful introduction for apprentices and similar readers.

ENGINEERING MECHANICS. By D. F. Gunder and D. A. Stuart. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd., 37 Essex Street, London, W.C.2. 391 pp. [Price 62s. 0d. net.]

This book provides a clear transition between the classical approach to engineering mechanics and the newer vector treatment. The section on statics is concerned with equilibrium in its various forms associated with frames, joints, and solid bodies, also friction and flexible cables. In a separate section, the authors deal with particle dynamics, relative motion, the dynamics of rigid bodies, and vibrations.

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## Machine Tool Exports and Imports

### EXPORTS OF MACHINE TOOLS

Type of Machine	Month ended January 31	
	1960	1961
	Value £	Value £
New, complete—		
Bar and chucking automatics .....	81,820	71,183
Boring machines:		
Vertical .....	38,248	171,709
Other .....	70,272	131,495
Drilling machines .....	111,632	124,360
Gear-cutting machines .....	197,954	110,044
Grinding, lapping and honing machines ...	213,692	284,887
Lathes:		
Capstan and turret .....	148,470	312,105
Other .....	336,130	359,444
Milling machines .....	211,379	258,359
Planing machines .....	31,199	53,613
Presses:		
Hydraulic .....	102,350	117,159
Other .....	57,831	129,826
Punching and shearing machines .....	40,995	94,848
Other plate and sheet metal working machines, including straightening rolls	42,354	96,360
Screwing and threading machines .....	89,355	111,071
Shaping and slotting machines .....	47,211	48,545
All other machines .....	213,055	388,030
Used machines, complete .....	55,155	37,354
Parts .....	220,724	467,253
<b>Total .....</b>	<b>2,309,826</b>	<b>3,367,645</b>
<b>Destination</b>		
Union of South Africa .....	96,324	147,740
India .....	244,972	606,818
Australia .....	420,077	455,916
New Zealand .....	23,293	92,505
Canada .....	151,756	137,087
Other Commonwealth countries .....	160,420	236,963
Soviet Union .....	68,364	111,345
Sweden .....	98,926	71,451
Western Germany .....	95,824	150,006
Netherlands .....	43,486	96,192
France .....	117,571	221,102
Spain .....	83,103	80,410
Italy .....	27,015	185,400
U.S. America .....	228,570	136,964
Other foreign countries .....	450,125	637,746

### IMPORTS OF MACHINE TOOLS

New, complete—		
Bar and chucking automatics .....	61,821	82,333
Boring machines .....	127,317	66,023
Drilling machines .....	16,388	37,278
Gear-cutting machines .....	14,676	250,956
Grinding, lapping and honing machines ...	293,849	451,406
Lathes .....	177,640	293,959
Milling machines .....	222,579	232,401
Planing, shaping and slotting machines ...	10,229	80,084
Presses .....	76,719	126,605
All other machines .....	310,250	381,591
Used machines, complete .....	108,935	55,041
Parts .....	223,761	310,903
<b>Total .....</b>	<b>1,644,164</b>	<b>2,368,580</b>
<b>Country of Origin</b>		
Western Germany .....	536,747	651,429
Switzerland .....	225,437	331,437
U.S. America .....	478,587	958,218
Other countries .....	403,393	427,496

In February the value of machine tool exports was £2,654,721, which brought the total for the first two months to £4,022,366. The corresponding figures for imports were £2,405,193 and £4,770,231.

## Obituary

MR. RICHARD KIRCHNER. We regret to announce the sudden death, on April 1, of Mr. Richard Kirchner, M.I.Mech.E., M.I.Prod.E., deputy chairman and joint managing director of Arnott & Harrison, Ltd., 22 Hythe Road, London, N.W.10, and a director of Crawford Collets, Ltd., and of Omes, Ltd.

Mr. Kirchner, who would have been 53 next month, was a founder member of the Gauge and Tool Makers' Association and a signatory to the original Memorandum and Articles in 1942. He was keenly interested in the affairs of the Association and as a member of the Council from its inception, he missed only two monthly meetings during the 18½ years of its existence. Hon. treasurer from 1947 to 1956, he became a vice-chairman in the latter year, and a vice-president in 1960.

Mr. Kirchner served on many committees of the Association, including those concerned with education and apprenticeship, exhibitions and publicity, finance, and technical matters. He will be greatly missed by many friends in the gauge and tool, engineering, and allied industries.

## Trade Publications

NASH & THOMPSON, LTD., Hook Rise South, Tolworth, Surrey. Folder concerned with a wide range of creep and rupture testing machines, furnaces, and extensometers, which is now being marketed by the company. These units are based on designs which have previously been supplied to industry to meet special requirements.

ROTAX, LTD., Willesden Junction, London, N.W.10.—Catalogue leaflets concerned with the following products: type A.2102 linear actuator; AT.0401 pneumatic linear actuator; B.3001 generator; B.3101 generator; CA.2501 3-phase a.c. motor; CA.2601 a.c. motor and gearbox; M.6301 control valve; and ZA.12301 static timer.

IMPERIAL ALUMINIUM CO., LTD., P.O. Box 216, Witton, Birmingham 6.—Illustrated brochure showing the wide range of application of Impalco extruded and drawn products. Information is also included on the Impalco range of aluminium and aluminium alloys that is available, together with details of the forms in which they are produced.

LONDEX, LTD., Anerley Works, 207 Anerley Road, London, S.E.20. List No. 166/D describes the company's new range of types BC and LC contactors for operation on a.c. or d.c. List No. 109/D gives the latest information on the KR telephone-type d.c. relays with heavy-duty contacts, also on the types KR/M and KR/TA which have been added to this range.

WORTHINGTON-SIMPSON, LTD., Newark, Notts. Well-presented brochure (WS—5150/6009) giving a brief history of the company followed by illustrations showing typical activities in the pattern, core, and shell moulding shops; laboratories; iron and brass foundries; tool-room; inspection department; machine and fabricating shops; and fitting and assembly department. Views of some typical installations are also included.

## Industrial Notes

**PATEREX, LTD.** The address of this company is now Cray Avenue, St. Mary Cray, Orpington, Kent (telephone, Orpington 31555).

**F. PERKINS, LTD.**, Peterborough, announce that they have received a substantial order for their 1.6-litre Four 99 diesel engines for Russian Volga cars which are to be assembled in Antwerp by Beherman-Demoen.

**KABI (ELECTRICAL & PLASTICS), LTD.**, Cranborne Road, Potters Bar. The telephone number of this company has been changed to Potters Bar 53444. Callers from London dial PR followed by the number.

**TELCON PLASTICS, LTD.**, is the title of a new company which has been formed to take over the entire range of activities of the Plastics Division of the Telegraph Construction & Maintenance Co., Ltd. The address of the company is Green Street Green, Orpington, Kent.

**FERODO, LTD.**, recently opened new premises at Ferodo House, 116 Princes Street, Ipswich. Greater storage capacity is available as compared with the former premises in Ipswich, and the orderly arrangement of stocks will permit more rapid counter service.

**COURSE ON TECHNICAL WRITING.** There will be a course of six evening lectures on "Some Problems of Technical Writing" at Borough Polytechnic, Borough Road, London, S.E.1, starting on April 26. The lectures will be on Wednesdays from 7.00 to 9.00 p.m. and the fee for the course is £1.

**ENGLISH STEEL CORPORATION, LTD.**, River Don Works, Sheffield, 9, have placed an order, valued at nearly £1,000,000, with the Heavy Plant Division of Associated Electrical Industries, Ltd., for electrical equipment for four rolling mills to be installed at the new Tinsley Park Works, Sheffield.

**CONROY COPYING CONSULTANTS, LTD.**, is the title of a new company which has been formed to advise existing and potential users as regards the most suitable copying machines for their particular requirements. A photocopying machine centre has been opened at 33 New Cavendish Street, London, W.1 (telephone, Hunter 4211).

**HANCOCK & Co. (ENGINEERS), LTD.**, Progress Way, Croydon, are organizing a competition to find the oldest Hancock profiling machine in existence. The owner will be presented with a new OI, U-arm profiling machine, and the winning entry will be presented to the museum of Science and Industry at Birmingham.

**THE BRNO INTERNATIONAL TRADE FAIR** will be held this year from September 10 to 24. In the engineering sections exhibits will include, woodworking machines and tools, metal products, metallurgical plant, electronic measuring instruments, machine tools, powder metallurgy presses, welding equipment, and conveying and lifting equipment.

**TELEHOIST, LTD.**, Cheltenham. Exhibits of this company at the forthcoming British Trade Fair in Moscow will include an S.L.8 tipping gear actuating a sectional steel body; the Teleloader rack lifter; and a variety of

axial piston pumps and industrial hydraulic control units, among which may be mentioned the new Telepak hydraulic power pack.

**FORD INTERNATIONAL FELLOWSHIP PROGRAMME.**—It is announced that the Ford Motor Company Fund has made a grant to the Institute of International Education to provide for the award of some 50 International Fellowships under which outstanding scholars, from all areas of the free world, will go to U.S.A. during 1961 for graduate study at leading educational institutions.

**ROCOL, LTD.**, Rocol House, Swillington, nr. Leeds, are now supplying Rocol Molspeed molybdenum disulphide oil additive in 4-oz. polythene dispenser bottles, in addition to 10-oz. sealed cans. They also announce that Rocol Molspeed grease is now available in 8-oz. plastics tubes, from which, it is stated, grease guns can be easily and cleanly filled.

**JOHNSON, MATTHEY & Co., LTD.**, 73-83 Hatton Garden, London, E.C.1, announce that as a result of the installation of new equipment they are able to offer two grades of mercury for industrial use. Redistilled mercury has a maximum impurity content (mainly copper and silver) 5 parts per million, and triple-distilled, a maximum of 1 part per million.

**L.S.A. (EXPORTS), LTD.**, has been formed as a subsidiary of Opperman Gears (Holdings), Ltd., to handle exports within the Opperman Group. This company will operate from Hambridge Road, Newbury, and will offer services to other firms in the area in connection with export/import arrangements. This offer, it is stated, will not be restricted to engineering goods.

**NEWTON CHAMBERS & Co., LTD.**, Thorncliffe, Sheffield, will exhibit details and models of a wide range of metallic air and fuel gas recuperators and air heaters, for various types of industrial furnaces and boilers, at the Bournemouth conference of the Institute of Fuel. This conference, which will be concerned with waste heat recovery, will be held on May 15.

**JAPANESE MACHINE TOOL EXPORT PLANS.** A report in the *Japan Commercial Gazette* states that the Ministry for International Trade and Industry (M.I.T.I.) has recently announced a 5-year plan for increasing exports of Japanese machine tools. Among the provisions envisaged are the granting of freedom from anti-monopoly laws and exceptional tax concessions for machine tool builders who amalgamate for the purpose of expanding the industry.

**WAVERLEY GOLD MEDAL ESSAY COMPETITION.** Entries are invited for this year's competition for the best essay of about 3,000 words "describing a new project or practical development in pure or applied science, giving an outline of the scientific background, the experimental basis, and the potential or actual application of the idea to industry." Full particulars and entry forms can be obtained from The Editor, *Research*, 88 Kingsway, London, W.C.2.

**NICKEL CONSUMPTION.**—The International Nickel Company of Canada, Ltd., report that as a result of an increase in the demand from Western Europe, nickel consumption

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in the free world in 1960 reached the record total of 515,000,000 lb., which was about 20 per cent more than in 1959. The share of Western Europe in this total was 235,000,000 lb., as compared with a consumption of 170,000,000 lb. in 1959.

ADREMA, LTD., Telford Way, London, W.3, have acquired two factory buildings in Western Road, Bilton Estate, Portsmouth, with a combined area of 20,000 sq. ft., to form their first "satellite" plant. These buildings will increase the total factory area of the company to 130,000 sq. ft. They will house an extension of the main plate embossing department, a servicing section, an overflow machine shop, the new Electronics Division, and the Photocopy Division.

CIBA UNITED KINGDOM, LTD., with an authorized share capital of £3,000,000, has been formed by CIBA, Ltd., Basle. The registered office is at 96 Piccadilly, London, W.1, and it will act as a holding company for the CIBA interests in the United Kingdom by acquiring (from CIBA, Ltd.) the issued share capital of the three wholly owned subsidiaries, CIBA Laboratories, Ltd., CIBA Clayton, Ltd., and CIBA (A.R.L.), Ltd., together with the controlling interest held by CIBA, Ltd., in the Clayton Aniline Co., Ltd.

IBM UNITED KINGDOM, LTD., 101 Wigmore Street, London, W.1, will open the IBM Data Centre in June, at 58 Newman Street, W.1. This centre will be provided with 7,090 and 1,401 data processing systems and supporting equipment for the use of commercial and scientific organizations, which will write the computer programmes and operate the machines. The customer will accept full responsibility for operations, but IBM will provide maintenance staff and specialists who will be available, without extra charge, to advise programmers and operators as regards the most effective use of the equipment.

VAUXHALL MOTORS, LTD., Luton, report that although the number of hours worked in their factories rose from 47,280,608 in 1959 to 48,343,957 in 1960 there was a decrease in the number of injuries to employees which involved lost time, from 261 to 232. The injury rate in 1960 (number of injuries per 100,000 hours worked) was 0.48, as compared with 0.55 in 1959 and 3.30 in 1945. Five departments of the Luton and Dunstable factories, with a total of 4½ million working hours, had clear records and qualified for "safety awards of merit" presented annually by the company.

EXHIBITION OF TRAINING. The chief feature which is being arranged by Brighton Education Committee during Commonwealth Technical Training Week will be an Exhibition of Training in the Brighton Palladium. This exhibition will be open from the morning of June 1 until the evening of June 3. Exhibits will be provided by the nationalized industries, the public services, the armed forces, and local industry and commerce. Many of these exhibits will take the form of "live" demonstrations of training techniques, and there will be information and enquiry desks on most stands. Particulars of this exhibition and of other plans for the "week" can be obtained from the Director of Education, Education Offices, 54 Old Steine, Brighton.

## MACHINERY'S ENQUIRY BUREAU

For many years MACHINERY has provided an enquiry service not only for subscribers and advertisers but for all engineers in need of such information as the names of makers—or their agents—of machines or equipment for performing particular operations, suppliers of various classes of material, firms with facilities for undertaking certain types of work, owners of trade names, and agents for foreign machine builders. If you have such a problem write (MACHINERY, Enquiry Bureau, Clifton House, 83-117 Euston Road, London, N.W.1) or telephone (Euston 8441, 2 lines). This service is, of course, entirely free.

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## Coming Events

**INSTITUTION OF PLANT ENGINEERS.** *Kent Branch.* April 19, at 7 p.m., at the King's Head Hotel, High Street, Rochester; lecture on "Plastics Bearings," by J. F. L. Ludgate. *West and East Yorkshire Branch.* April 24, at 7.30 p.m., in the Houldsworth School of Applied Science, Leeds University; lecture on "The Introduction of Planned Maintenance Systems," by A. F. Stedman.

**INSTITUTION OF PRODUCTION ENGINEERS.** *Birmingham Section.* April 19, at 7 p.m., at the Midland Hotel, Birmingham; lecture on "International Competition in Machine Tool Design and Production," by R. Asquith. *London Section.* April 20, at 7 p.m., at the Royal Commonwealth Society, Northumberland Ave.; "High-speed Cinematography in Production," by J. Hadland.

**INSTITUTION OF MECHANICAL ENGINEERS.** *Ordinary Meeting.* April 18, at 6.30 p.m., at the Chemistry Lecture Theatre, University of Leeds; lectures on "Influence of Rate of Strain-hardening in Machining," by P. L. B. Oxley, A. G. Humphreys and A. Larizadeh; and "Metal Cutting and the Built-up Nose," by W. B. Heginbotham and S. L. Gogia. *Southern Graduates' Section.* April 20, at 7.30 p.m., at the South Dorset Technical College, Weymouth; lecture on "Technical Education for the Engineer," by H. Buttolph.

## New Appointments

The following new appointments have been announced:—

**MR. E. A. ELMORE**, as a director of Gate Machinery Co., Ltd., 172-178 Victoria Road, Acton, London, W.3.

**MR. KENNETH ARTHUR OLIVER**, as chief metallurgist of the Brightside Foundry and Engineering Co., Ltd., Ecclesfield, Sheffield.

**MR. F. G. HAWKINGS**, as managing director and **MR. E. G. SMALLEY**, as deputy managing director of Textile Machinery Makers, Ltd., Oldham, following the death of Mr. George Hardman.

**MR. A. G. THOMSON**, formerly district manager in Aberdeen, as district manager in Edinburgh for Ferodo, Ltd. He succeeds Mr. W. S. Mowat, who has retired, and will also be responsible for the Aberdeen depot.

**MR. H. A. LATHAM**, as a director of Sanderson Brothers & Newbould, Ltd., Newhall Road, Sheffield. He first joined the company in 1938 and returned after service as a captain in the army. In 1953 he became forge and rolling mills superintendent.

**MR. H. W. G. HIGNETT** and **MR. JEAN M. DHAVERNAS**, as directors of The International Nickel Company (Mond), Ltd., Thames House, Millbank, London, S.W.1. Mr. Hignett will continue to hold the position of managing director of Henry Wiggin & Co., Ltd.

**MR. RAYMOND V. ELV**, M.I.E.E., M.I.Mech.E., a specialist in the field of the application of electrical transformers to arc welding and X-ray technology, as consultant to Gresham Transformers, Ltd., Gresham House, Twickenham Road, Hanworth, Middlesex.

**MR. G. E. LUNT**, as a director of John Hill & Sons (Iron Founders), Ltd., Wolverhampton, a member-company of

Staveley Industries, Ltd. Mr. Lunt is on the board of the parent company and is managing director of Bradley & Foster, Ltd., Darlaston, and the associated companies in the Staveley Group.

**MR. A. J. OGDEN**, A.C.A., as financial director of John Bass, Ltd., 36 The Broadway, Crawley, Sussex.

**MR. J. A. PERKINS** as a director of The Elgar Machine Tool Co., Ltd., 172 Victoria Road, London, W.3.

**MR. J. BELL**, M.I.Prod.E., M.I.Agr.E., M.N.E.C. Inst., as general works manager of Wolsley Engineering, Ltd., Wolsley Works, Electric Avenue, Witton, Birmingham, 6.

## Scrap Metals

†LONDON.—†Prices per ton for non-ferrous scrap metals free from iron are as follows:—Clean copper wire, untinned and free from lead and solder, £195; clean heavy copper, untinned and free from lead and solder, £190; copper wire No. 2, £184; clean light copper, £180; brazing copper, £168; gunmetal, £175; brass, mixed, £124; lead, net, £54; zinc, £45; cast aluminium, £105; old rolled aluminium, £110; battery lead, £27; unsweated brass radiators, £100; hollow pewter, £535; black pewter, £410.

MIDLANDS.—Recent market reports emphasize the firmness of tin, which, if anything, has shown further slight gains. An easier tendency appears to have developed in connection with copper although demand remains good. Market indications give the impression that buyers are a little cautious, which could possibly be due to an uncertainty that present values will be maintained. In general, merchants are finding business fairly brisk, and increased stocks, resulting from the usual pre-holiday demands for scrap clearance by works, are now being distributed. Competition is keen, but there is an optimistic view of increased future trade. The tone of the market for various types of metals is as follows:—

**Copper**—Heavy, bright, and No. 1 wire scrap are in demand although prices have eased slightly.

**Brass**—In the higher grades, including rod swarf and bar ends, there is little improvement. Mixed scrap is still sought by ingot makers at prices which are lower by £1 or £2 per ton.

**Gunmetal**—Requirements are firm, and the recent small increases in value are being maintained.

**Lead**—Outlook for this metal at the moment is not at all good. The recent increases were not maintained and prices are at least £2 per ton lower. The question as to whether producers will reduce output is still in the balance, and until a clearer picture of future production is afforded no better price tone can be foreseen, apart from the small increase that could result from greater demand.

**Aluminium**—With fairly steady business, prices showed no substantial change, but increases which started two or three weeks ago are being easily held.

**Zinc**—After a little unsteadiness, prices appear to have recovered and this metal is in quite good demand. It is likely that the future tone will be firm.

† George Cohen, Sons & Co., Ltd., 600 Wood Lane, London, W.12.  
‡ Subject to market fluctuations.

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The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. \* Sheffield price. ‡ Birmingham price.

# PRICES OF MATERIALS

All prices per ton except where otherwise stated.

## Pig Iron

### Foundry and Forge No. 3, Class 2

Middlesbrough (10 tons or over) £21 17 0

Birmingham (10 tons or over) £21 9 3

### Phos. Over 0.1 up to 0.4%

Birmingham (6 ton lots) £23 5 0

Grangemouth (6 ton lots) £23 10 0

## Hematite

### English No. 1 (10 tons or over)

N.E. Coast (made in N.E.) £23 19 0

Scotland £24 5 6

Sheffield £25 9 0

Birmingham £25 13 0

Welsh 10 tons or over £23 19 0

## Steel Products

Medium plates (50 tons and over) £43 16 6

Mild steel plates, ordinary (50 tons and over) £40 7 0

Boiler plates (50 tons and over) £42 17 0

Flat bars, 5 in. wide and under (50 tons or over) £39 1 0

Round bars, under 3 in. (50 tons or over) £39 1 0

Billets, rolling quality, soft U.T. (100 tons or over) £31 15 6

## Phosphor Bronze

Ingota (288) (A.I.D. d/d) £309 0 0

## Copper

Cash (mean) £228 7 6

Cold rolled and hot rolled sheets

4 ft. by 2 ft. by 10 SWG £300 10 0

Rods,  $\frac{1}{2}$  in. to  $\frac{3}{4}$  in. diam. £318 10 0

Tubes,  $\frac{1}{4}$  in. bore by 10 SWG, ton lots, per lb. 3s. 0½d.

Wire rod, black, hot-rolled ( $\frac{1}{4}$  in. to  $\frac{3}{4}$  in.), English £243 17 6

## Zinc

Refined, minimum 98 per cent purity, current month (mean) £83 11 3

## Brass

Tubes, solid drawn, per lb. 1s. 9½d.

Strip 63/37, 6 in. by 10 SWG coils, ton lots £254 10 0—£257 10 0

Rods,  $\frac{1}{2}$  to 3 in. diam. (59 per cent copper) 2s. 0½d.

## Yellow Metal

Condenser plates, per ton £186 0 0

Rods, per lb. 2s. 1½d.

## Aluminium

Ingots, min. 99.5 per cent £186 0 0

Canadian d/d £186 0 0

## Tinplates

\*U.K. Home trade:

Cold reduced, f.o.r. makers works (15-50 tons) £3 6 8

U.K. Export:

Hot rolled basis, f.o.r. works port 73s. 6d.—76s. 0d.

Cold reduced basis, f.o.r. works port 73s. 6d.—76s. 0d.

## Gunmetal

Ingots, B.S. 1400 L.G.2, delivered £220 0 0

\* Official maximum price, after allowing for adjustments for increase in price of tin.

## MAKERS' PRICES

### Hexagon Steel Bars<sup>1</sup>

Sizes in inches from 1 in. up to

2-21 and 2-41 a/f ex works, 2 ton basis £42 17 0

Free cutting black £47 6 6

### Reeled Steel Bars<sup>1</sup>

Single-reeled,  $\frac{1}{4}$  in. upwards, f.o.c. works (+ usual extra for sizes) £43 9 6

Free cutting £47 19 0

### Precision-ground Mild Steel<sup>1</sup>

1-in. diam. + 0.00025-in. 124s. 6d.

4-ton lots, per cwt. 124s. 6d.

### Bright Ground Stainless Steel Bars<sup>1</sup>

EN56AM (martensitic, free cutting) £304 10 0

EN58AM (austenitic free cutting) £377 10 0

Prices are basic, subject to extras

### High-speed Steel

Black random length bar. All prices basic, per lb., subject to extras:

Molybdenum "66" 6s. 5d.

Molybdenum "46" 6s. 3d.

14 per cent tungsten 6s. 11d.

16 per cent tungsten 7s. 4d.

18 per cent tungsten 7s. 9d.

22 per cent tungsten 9s. 2d.

5 per cent cobalt 10s. 10d.

4-75/5-25 molybdenum + 6-0/6-75 tungsten + 1-75/2-05 vanadium per cent (5-6-2) 6s. 7d.

Precision-ground, High-speed Free-turning Brass Rod<sup>1</sup>

$\frac{1}{8}$ -in. diam.  $\pm 0.00025$ -in., 2 ton lots, per lb. 2s. 7½d.

Grey Iron Rod

Die Cast<sup>1</sup> in random lengths 18 in. to 26 in. rough machined  $\frac{1}{4}$ -in. above listed size. Extra for definite lengths. Discounts for orders over £150.

Per cwt. net.

Mark I Mark III

$\frac{3}{8}$  or  $\frac{1}{2}$  in. 260s. 3d. 338s. 3d.

1 or  $\frac{1}{4}$  in. 208s. 4d. 267s. 3d.

$\frac{1}{2}$  to  $\frac{3}{4}$  in. 146s. 3d. 181s. 7d.

1 to 2 in. 112s. 7d. 133s. 6d.

2 to 3 in. 97s. 1d. 112s. 9d.

3 to 12 in. 91s. 9d. 105s. 3d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. diam. + 0.010 to 0.020 in., prices as quoted for die cast bar<sup>1</sup>

centreless ground 1 or  $\frac{1}{4}$  in. 208s. 4d.

+ 0.010 in. Extra

for hardenable  $\frac{1}{2}$  to  $\frac{1}{4}$  in. 146s. 3d.

alloy iron<sup>5</sup>  $\frac{1}{8}$  in. to 2 in. 112s. 7d.

Per cwt. net  $\frac{1}{2}$  to  $\frac{3}{4}$  in. 97s. 1d.

Stellite<sup>1</sup>

Welding Rods, plain

$\frac{1}{4}$  in. diam., per lb. 30s. 0d.

Toolbits

$\frac{1}{4}$  n. sq. x 4 in., each 22s. 3d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 3 Pratt, Levick & Co., Ltd., Chester. 3 Spartan Steel & Alloys, Ltd., St. Stephens Street, Birmingham, 6. 4 Sheepsbridge Alloy Castings, Ltd., Sutton-in-Ashfield. 5 "Flocast." Harold Andrews Sheepsbridge, Ltd., Halesowen. 6 DeLoro Stellite, Ltd., Highlands Road, Shirley, Solihull.

## BASIC PRICES FROM LONDON STOCK<sup>1</sup>

### Free Cutting Steel

Bright cold drawn:

(Usaspead) over 1 to 2 in. £59 4 6

Lead bearing (Usaled) £63 11 0

Precision ground,  $\frac{1}{4}$  in. £84 14 6

### Bright Drawn

M.S. bars (M.M.C.) over  $\frac{1}{4}$  to 2 in. £56 10 0

Square edge flats (Usafat) £73 6 6

M.S. angles (Usaspead) £100 6 6

Case hardening (EN) (Usacase) over  $\frac{1}{4}$  to 2 in. £62 10 0

M.S. bars (EN3B) (Usamild) over  $\frac{1}{4}$  to 2 in. £58 16 6

Carbon manganese semi-free cutting case hardening (EN202) (Usaspead 202) over  $\frac{1}{4}$  to 2 in. £71 5 0

35/45 ton tensile (EN6) (Usen) over 1 to  $\frac{1}{4}$  in. £67 3 0

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18-, 24-, and 36-in. lengths (Usaspead). List prices plus 10 per cent, less 5 per cent.

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(0-194-in. to  $\frac{1}{4}$ -in.)

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" "Supreme" }

" "Cobalt 10 }

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## HiFEED serrated heavy duty milling cutters

Patent Application No. 8700/59

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HiFEED serrated heavy duty cutters are designed to provide a combination of high rate of stock removal and good surface finish.

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**INCREASED PRODUCTION**, particularly on work hardening and high tensile materials.

**EFFICIENT HEAT DISSIPATION** resulting from the break up of the cutting edges enables **HIGHER FEEDS AND SPEEDS** to be employed.

Primarily designed for heavy stock removal HiFEED cutters produce a surface finish acceptable for most applications. An alternative design, offering similar advantages plus superior surface finish when required, is also available. HiFEED cutters **INCREASE** production **REDUCE** costs.

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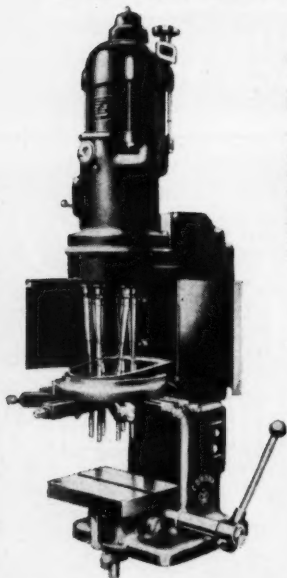
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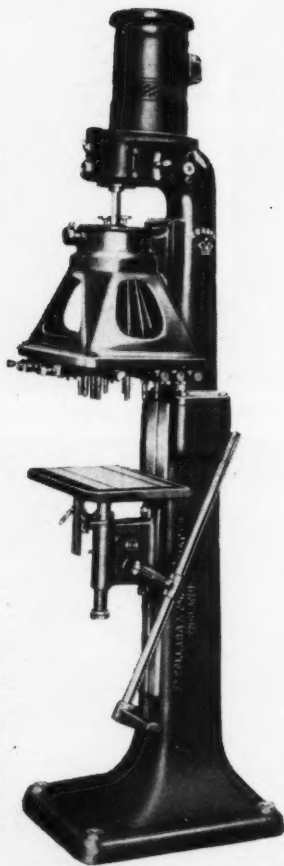


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OF 12in. — 8in.  
MAXIMUM DRILLING CAPACITY  
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These machines keep costs low on multiple repetition drilling. Any number of spindles up to 12 can be employed and adjustment is rapid and simple. Feed is by lever and rack-operated table with a vertical adjustment of 20in. Available with electrical reverse.

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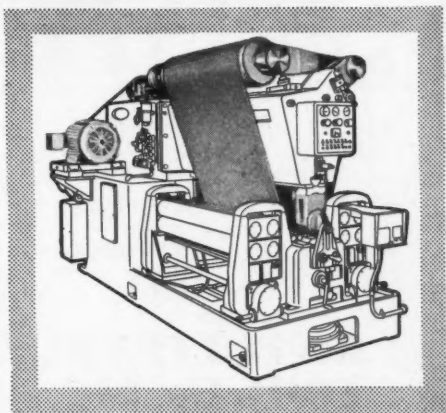


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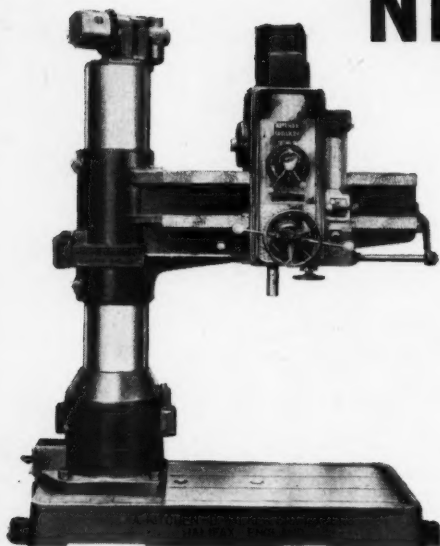
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4ft. 0in. model E2 Shown.



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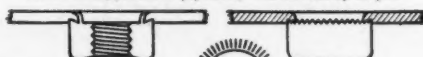


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New type permanent insert bush single blow fixing. Suitable for sheet metal, plastic or plywood. All threads up to 1/2in.



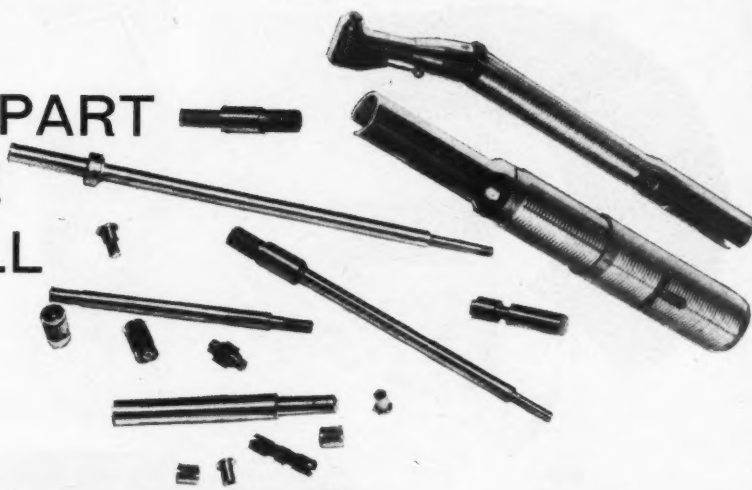
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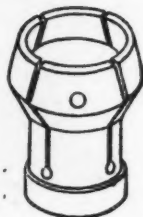
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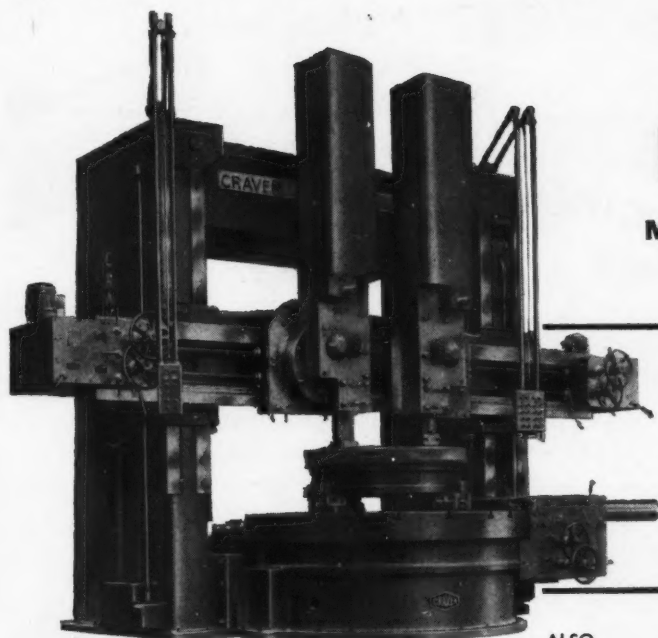
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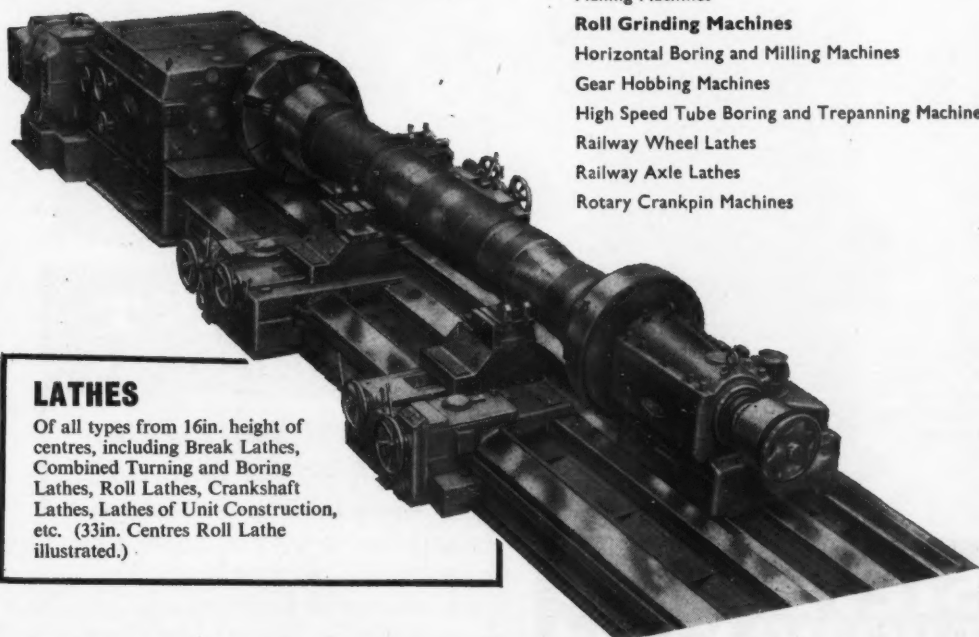
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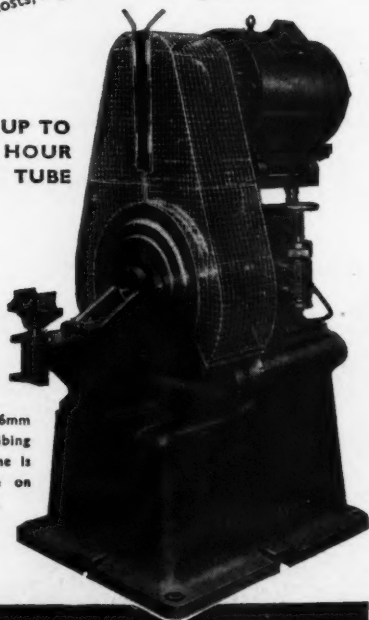
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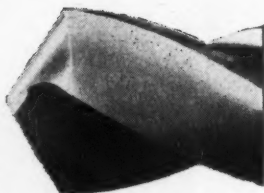


A short 16mm film describing this machine is available on application.

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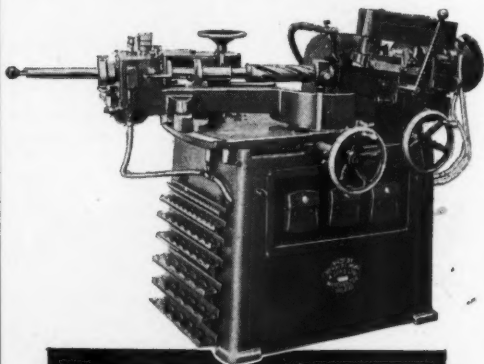
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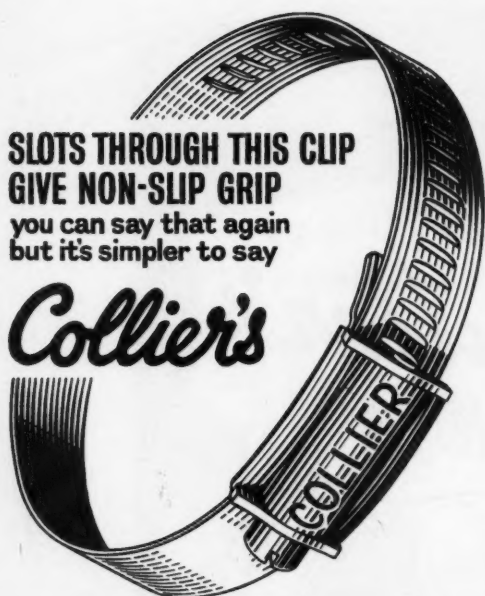


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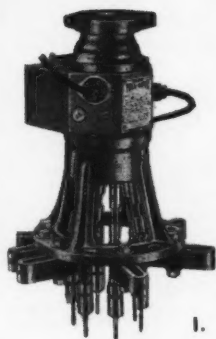


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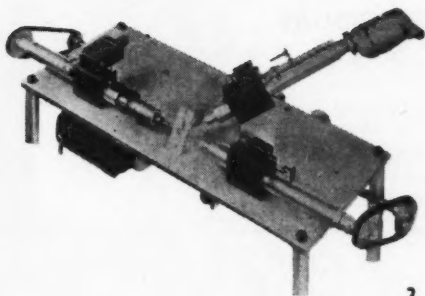
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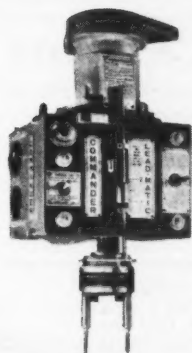
# MULTI-DRILLING & TAPPING



1.



2.



5.

## 1. MULTI-TAPPER

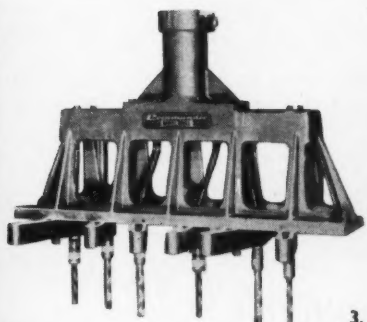
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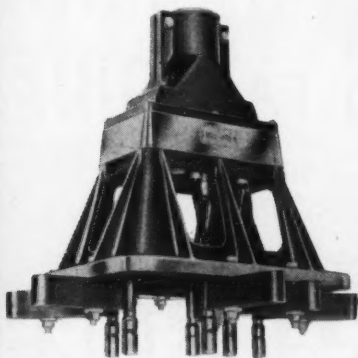
Compact low-priced units for short or long run drilling or tapping set-ups; pneumatic or hydraulic feed; motor, flexible shaft or pulley drive. ½in. or ¾in. capacity, 4in. stroke.

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3.



4.

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combines the LEADMATIC TAPPER and a Model "200" Twin Drill Head. Capacity 2BA, 2½in. stroke, adjustable between ½in. and 1½in. centres.

As separate units, the LEADMATIC taps from 10BA to ½in.—16, and the "200" drills up to ½in., with ½in. to 2in. centres.

\* Can be used for multi-tapping by means of the Motor Reversing Unit.

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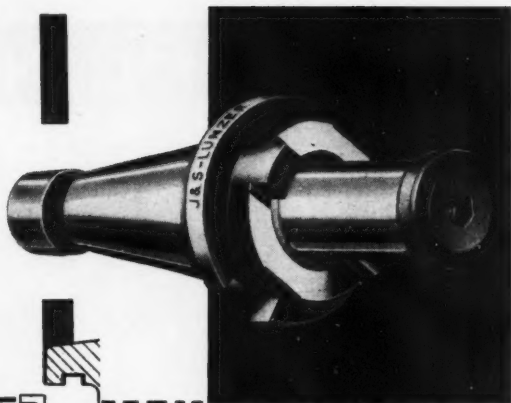
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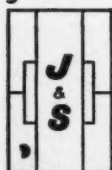
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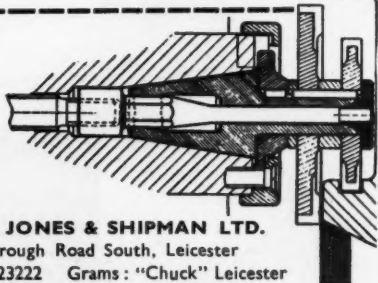
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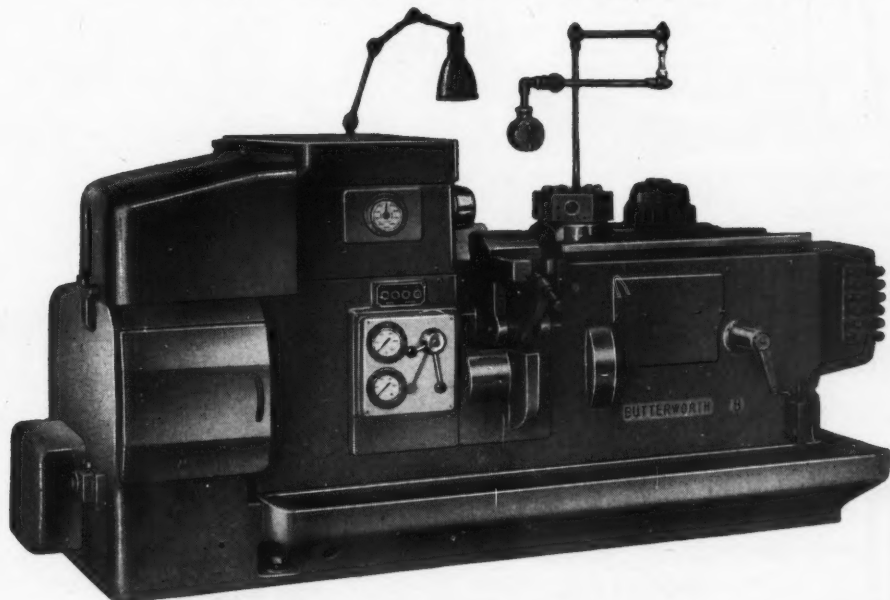
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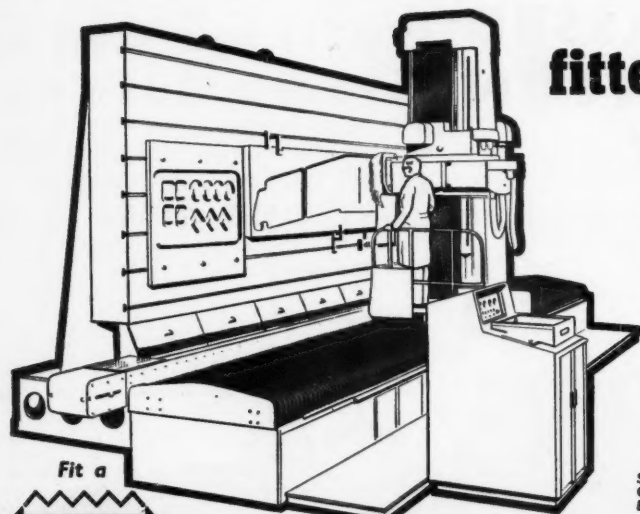
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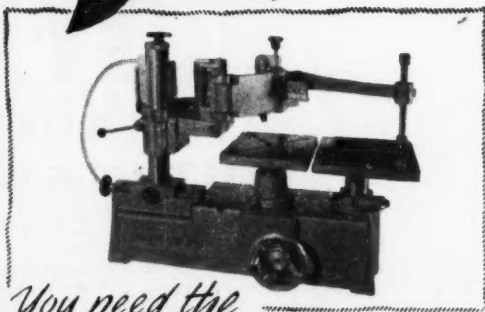
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Tests carried out under actual production conditions and with the co-operation of some of the largest engineering groups in this country, prove emphatically that **BLACK-MOLY CUTTING FLUIDS ARE SUPERIOR**. Results include tool life increases up to 40% and production increases of 300% to 500%.

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Our technical engineers are entirely at your disposal for help and assistance in advising the correct grade for any tricky machining problem.

*Extracts from a recent P.E.R.A. report on comparison between BLACK-MOLY SOLUBLE CUTTING OIL and the same SOLUBLE CUTTING OIL WITHOUT BLACK-MOLY. Tests included drilling and turning on alloy steel EN.25 heat treated to 70 ton U.T.S. condition.*

"It was established that as the cutting speed and feed rate were increased, the differences between the cutting fluids became noticeable. At cutting speeds 70 and 80 ft. per min. and feed rate 0.0138 in. per rev. the tool life was greater using the molybdenised cutting fluid, than the tool life obtained by using the straight soluble cutting fluid."

Cutting Speed ft. per min.	Feed Rate in. per rev.	* TOOL LIFE (min.)	
		Straight Soluble Cutting Fluid	Molybdenised Cutting Fluid
70	0.0138	43	60
80	0.0138	2½	15

Depth of cut 0.100 in.

\* High speed steel tool life expressed as the actual cutting time measured in minutes before tool failure. The tool was considered to have failed when the maximum wear exceeded 0.040 in. on the nose radius of the tool.

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FOR FULL DETAILS  
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**BLACK-MOLY IS BEING USED ALL OVER THE WORLD IN EVER INCREASING QUANTITIES**

This unique material, in itself a true natural lubricant, is capable of withstanding pressures up to 40 tons per sq. in. and temperatures up to 750°F. Add this to specially formulated cutting oils and you have —

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Combined Internal & External

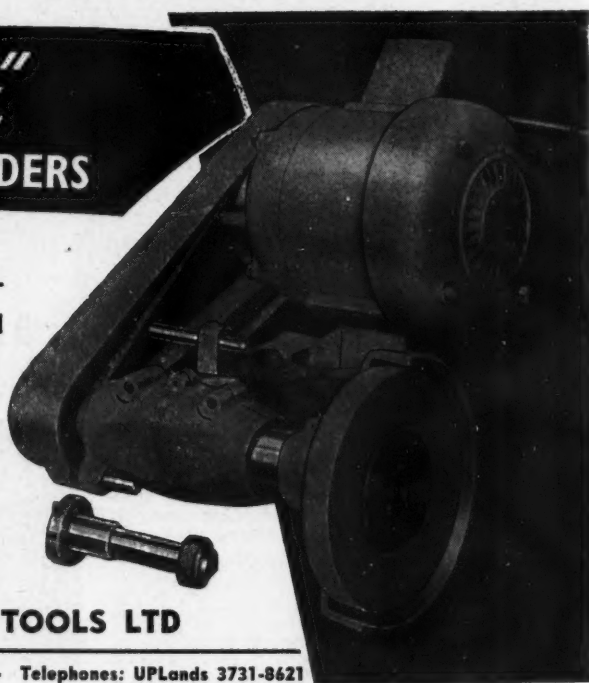
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Motors from  $\frac{1}{4}$  to  $7\frac{1}{2}$  H.P. external wheels 3" to 20" dia. internal speeds up to 40,000 R.P.M.

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And now — a brand new double range of specially cut files. One for BRASS — the other for ALUMINIUM. The most important feature of these new files is that they solve the old problem of clogged teeth after filing non-ferrous materials. The set and shape of the teeth have been so designed that swarf cannot become trapped in the file. The range of shapes and sizes available in both cuts — is similar to that of Engineers' files.

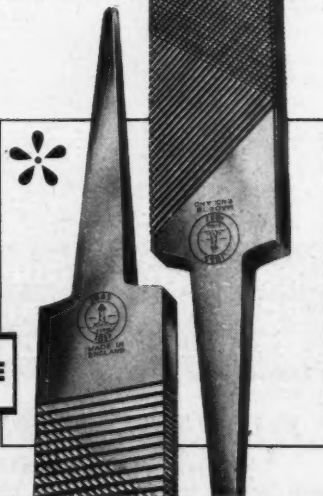
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Monmouth Works, Malinda Street  
SHEFFIELD . 3    PHONE: SHEFFIELD 28916



For immediate identification each file has the tang and shoulder appropriately coloured Brass or Aluminium.



**LIGHTHOUSE**

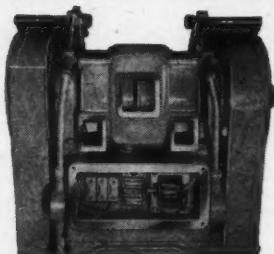
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# THE NEW MURAD EG8 DUSTLESS GRINDER

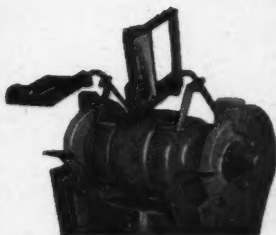
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- Impeller Capacity Trebled
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- Now Standard

These are some of the many improvements embodied in the new EG.8 making it without question the best off-hand Grinder in the world. The Murad Dustless Grinder is unique. It embodies its own dust inhibitor which offers protection to both worker and employer and makes the provision of a separate dust extraction plant unnecessary. It can be placed anywhere in the shop to suit the sequence of operations, even in close proximity to precision machines without endangering their slides. The repeat order is the finest tribute that a customer can pay to the efficiency and reliability of a machine tool. Britain's industrial giants have paid this tribute to the Murad Dustless Grinder.

Amongst many Users who send us a constant stream of repeat orders are such world-famous firms as Mullards, Pressed Steel, G.E.C., Atomic Energy Authority, B.T.H., British Oxygen Gillette Industries, Steflo, etc., etc.



Control switchgear is designed into the machine and not added as an afterthought.



The above illustration shows the eyeshield swung up for ease in changing lamps, etc.

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SMOOTH, RAPID AND ACCURATE CUTTING  
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OVERHEATING AND WITH MINIMUM BURR

**L. J. H. BALLINGER LTD**

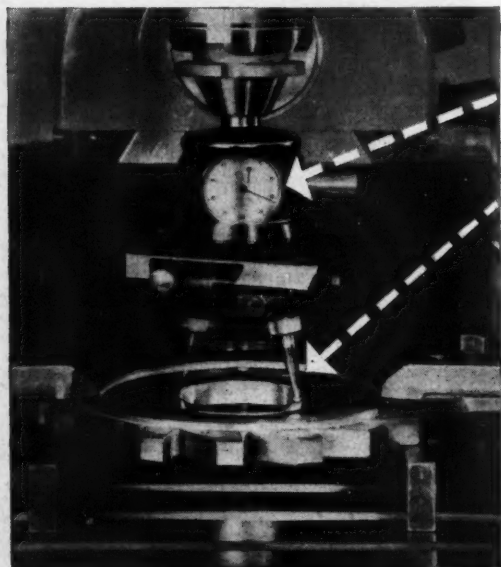
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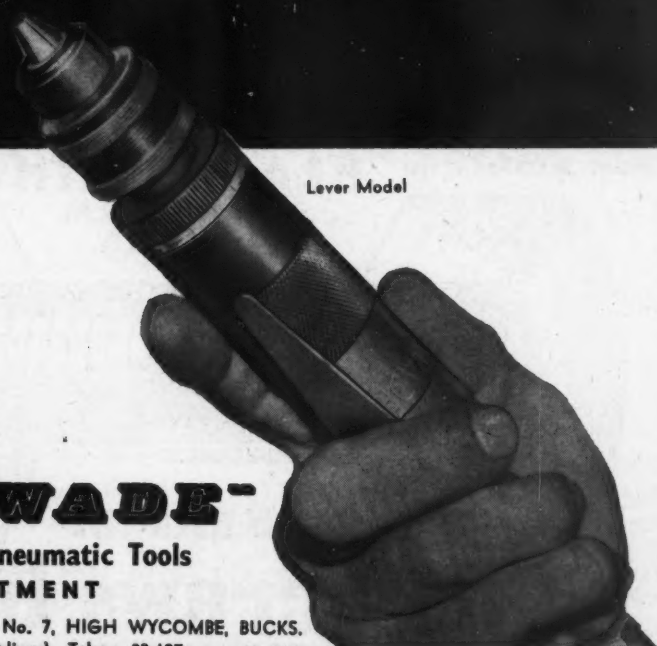
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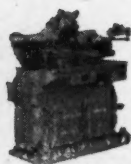
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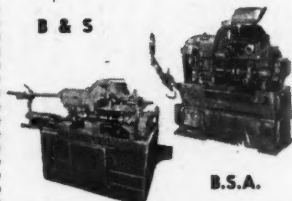
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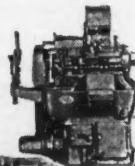
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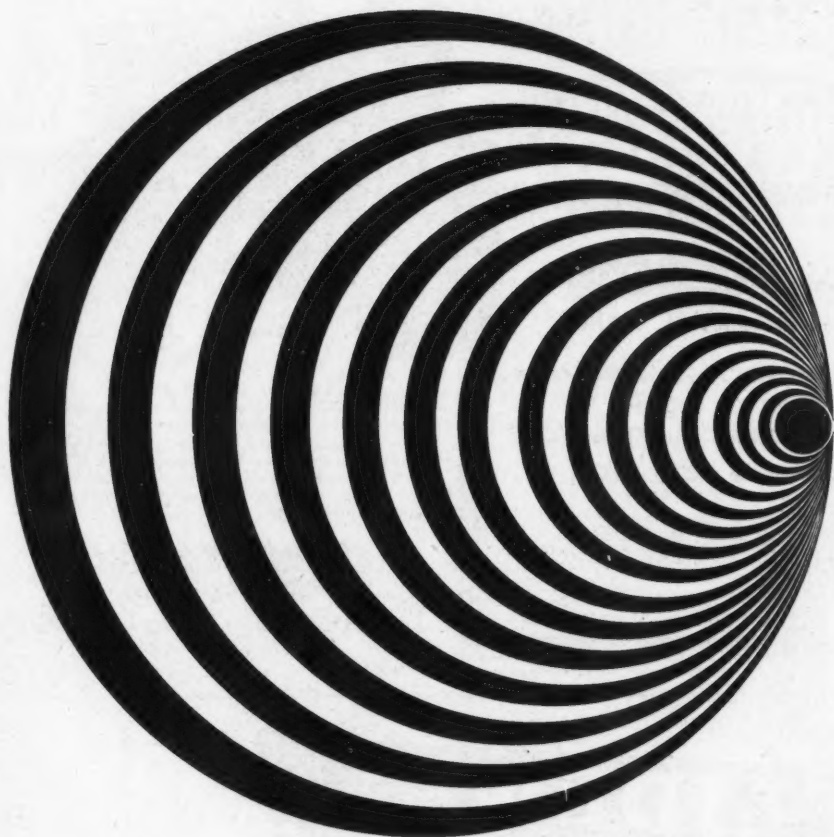
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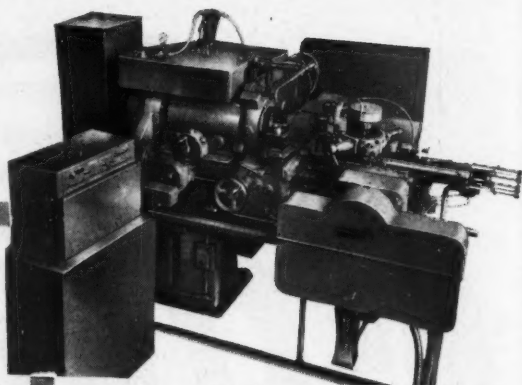
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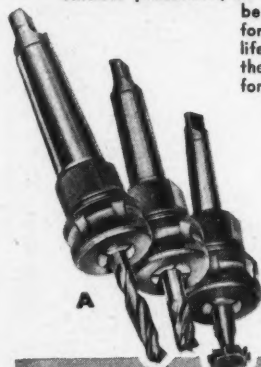
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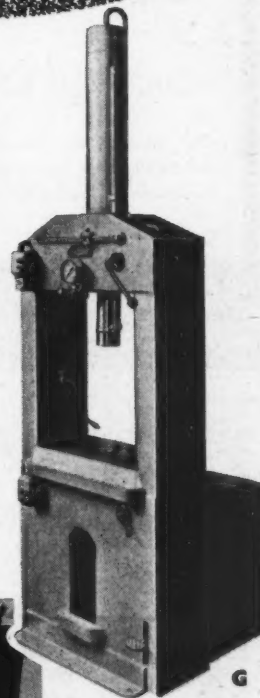
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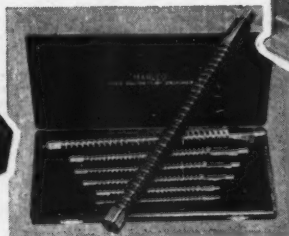
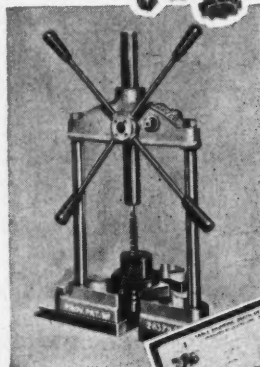
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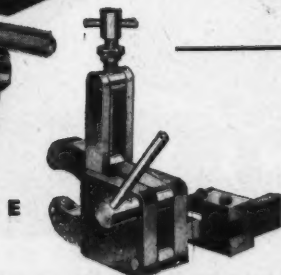
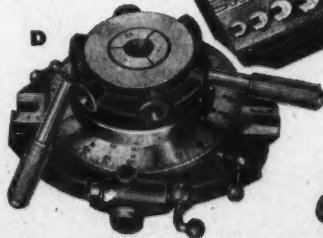


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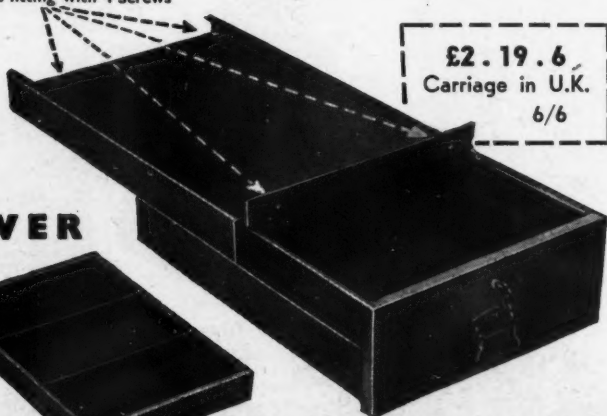


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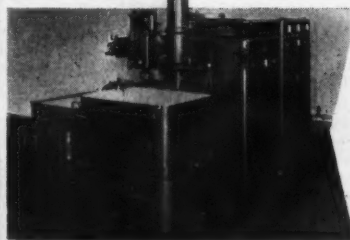
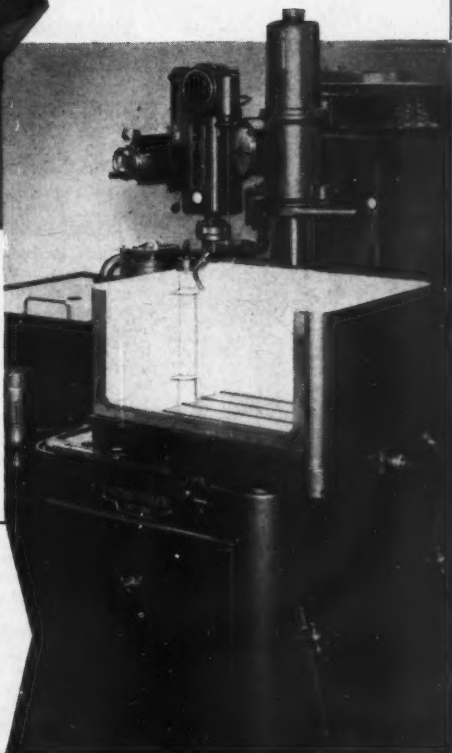
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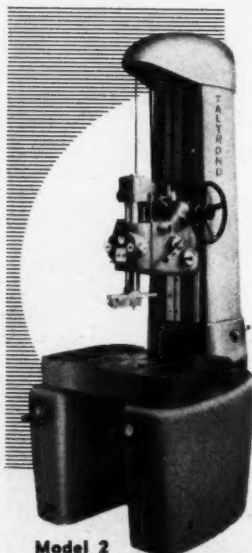
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Made in diameters from  $\frac{1}{8}$ " to 10" with bores to suit, and any quantity, material, brass, or steel shim stock, in thicknesses between .002" and .06". Also laminated shims up to 6" dia. Tab washers and shims of irregular shapes can also be produced. We shall be pleased to receive your enquiries.

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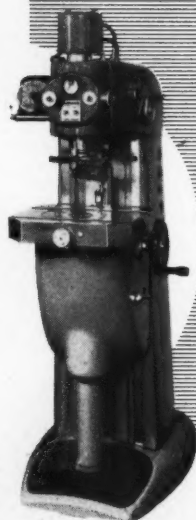
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Model 50

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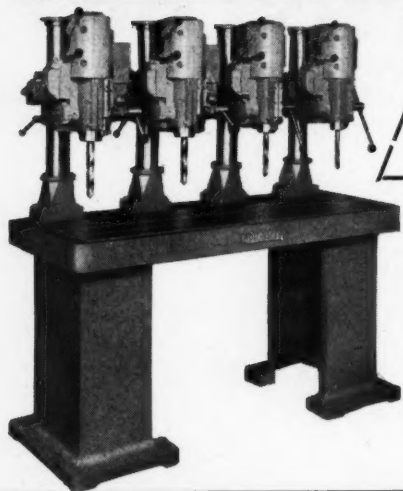
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 a ground finish . . . . .**

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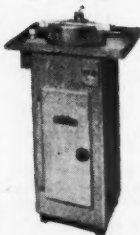
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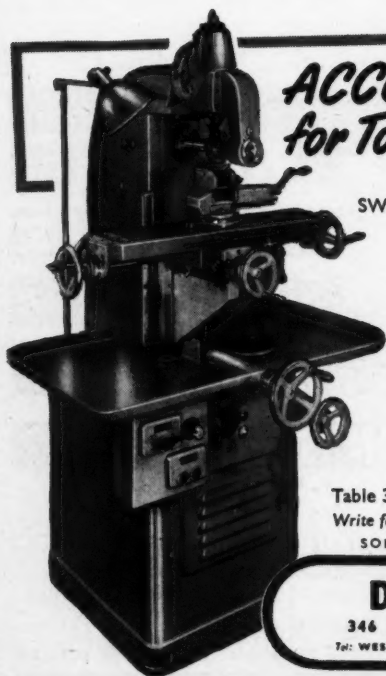
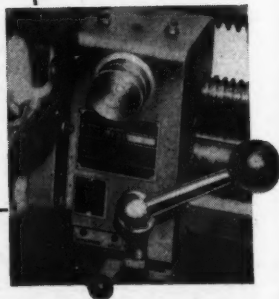


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In such an application, the paper ribbon filter allows air to flow freely and provide adequate filtration, and water separation. A Tecalemit ribbon filter is sufficiently robust to withstand pressure drops well in excess of normal working conditions.



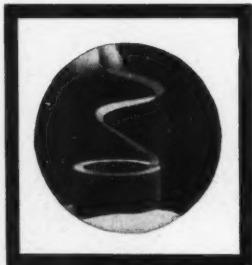
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The elements are formed to resin impregnated cellulose ribbon, wound helically and electrically fused into an open-ended cylinder. Innumerable microscopic orifices between the ribbons allow a very high flow rate, while retaining impurities on the outside or inside surfaces, according to direction of flow.

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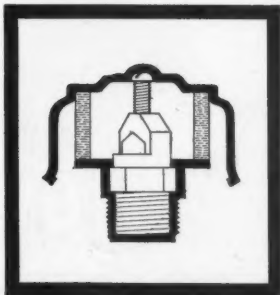
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*Tecalemit Breathers provide pure air cheaply and efficiently*



# TECALEMIT

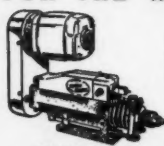
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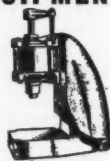
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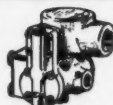
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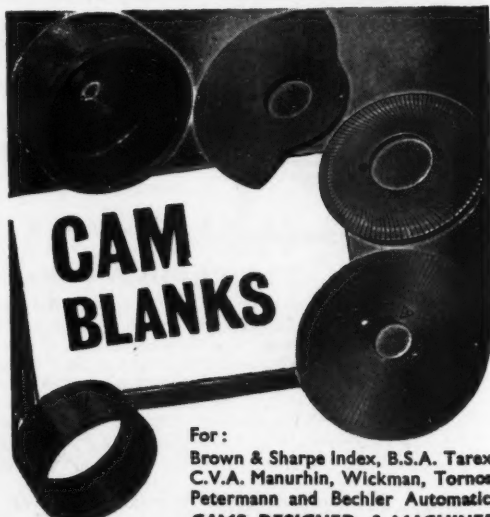
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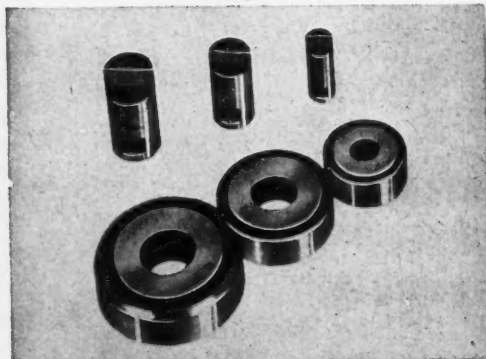
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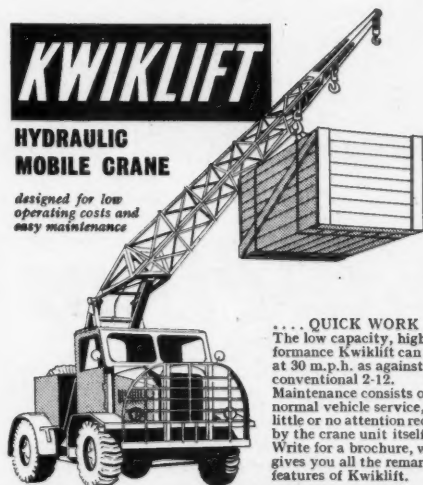
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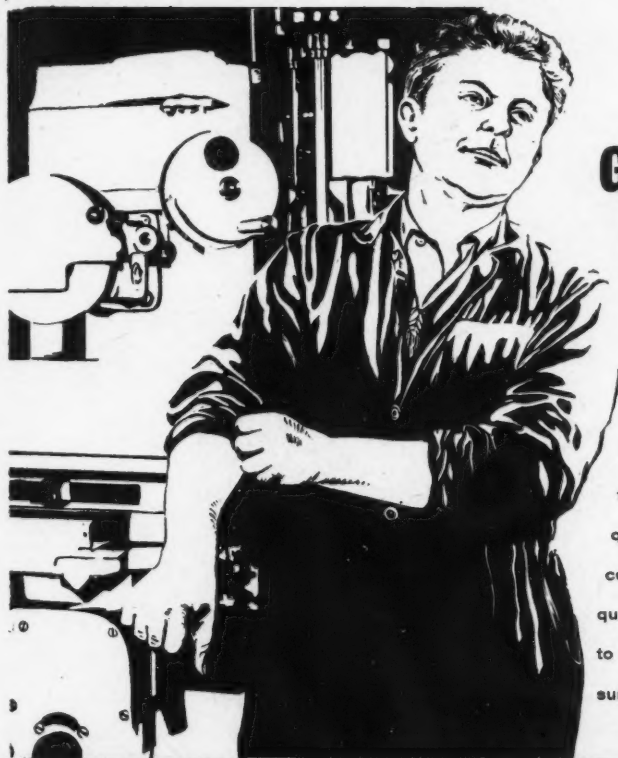
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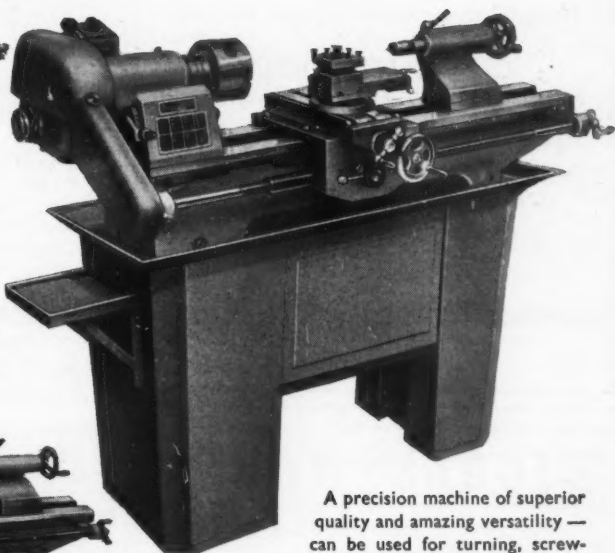
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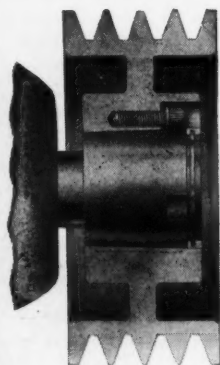
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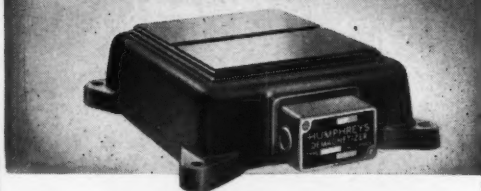
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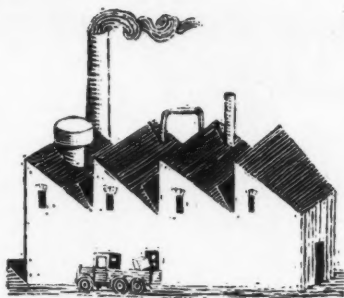
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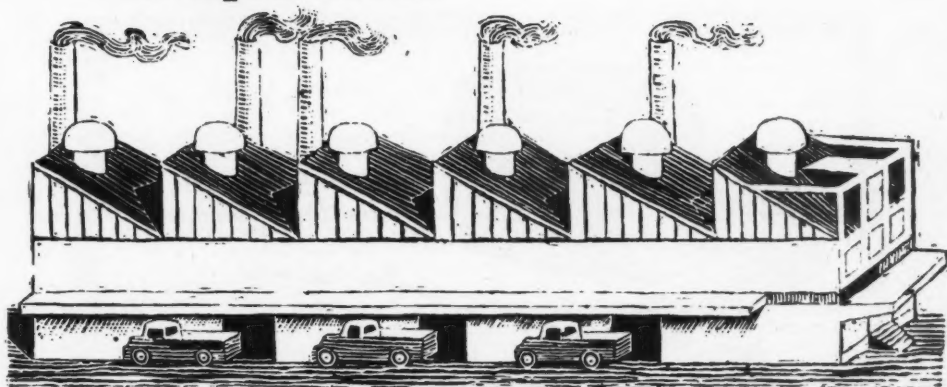


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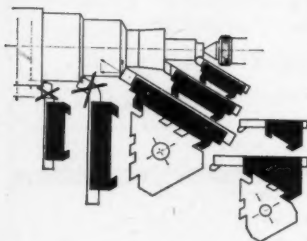
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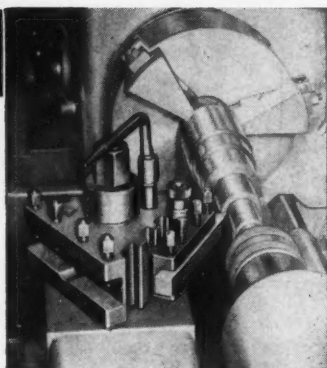
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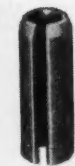
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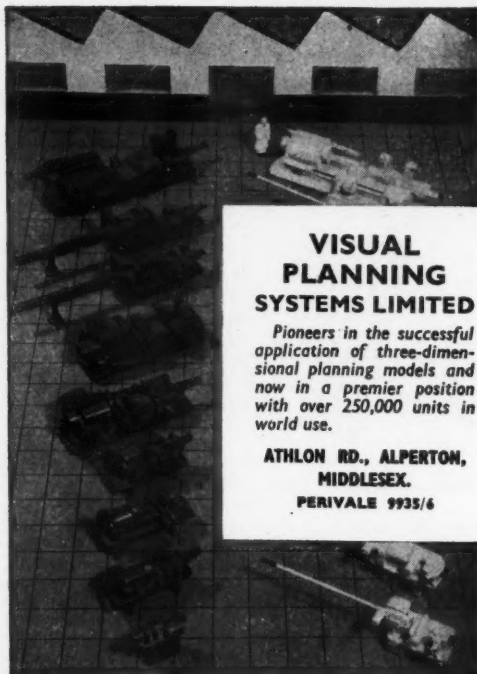


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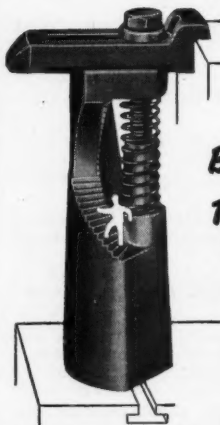
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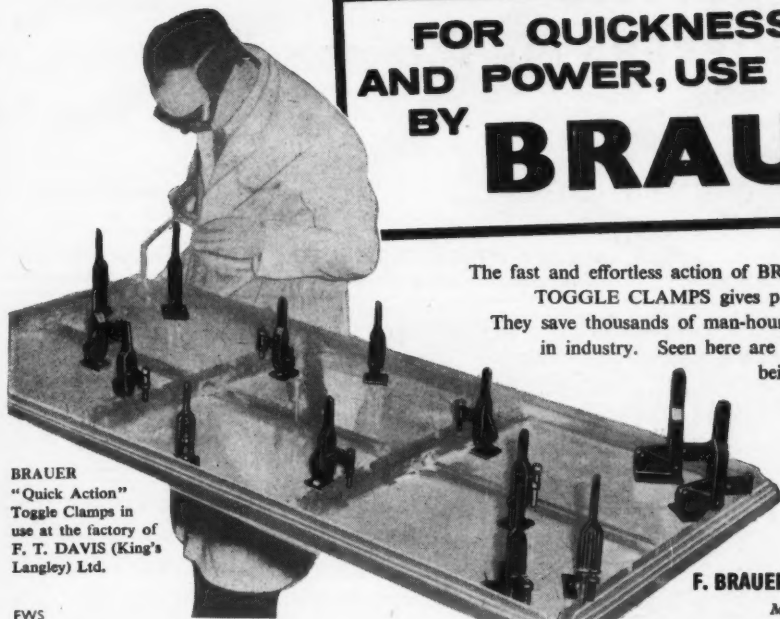
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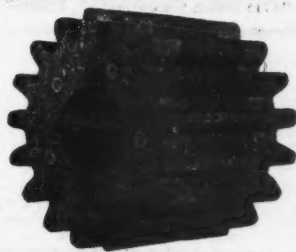
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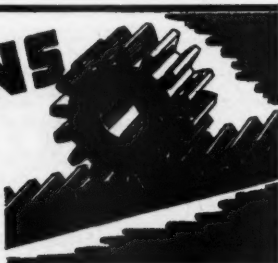
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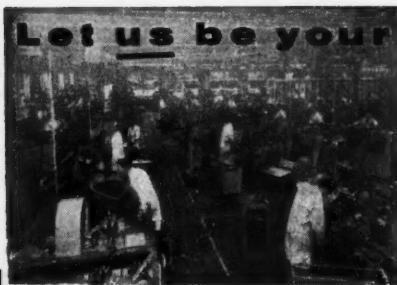
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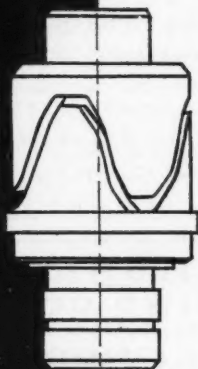
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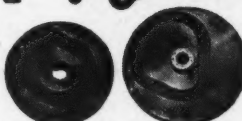
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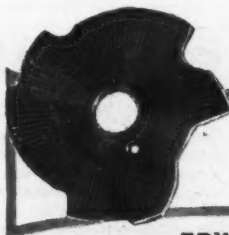
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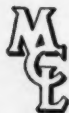
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prices. Pratt, Taylor, etc., 3-jaw and 4-jaw, 5in. to 26in.—List from EUCCO TOOLS, 44, London Road, Kingston, Surrey. Phone: Kin. 9029.

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Revolving Centres for Turret/Capstan Lathes, diameter of head 3in. x 2in. wide, with 1in. dia. shanks only overall 5in., at 77s. 6d. each, post paid.—ACENTTOOLS, 610-614, High Road, Chiswick, W.4. CHL 8418.

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of all types can be supplied from our American Showrooms. Send your enquiries to K & C MACHINERY, Ltd., Stephen Street, Coventry. Telephone: Coventry 23669.

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S.S. & S.C. Lathe with taper turning, motorised 440/350, good condition. Below.

Precimax Cylindrical Grinder, 6 x 24.

Model MPL Hydraulic, motorised, 440/350,

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Machine, independent 4-speed motors and

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UNIVERSAL MILLING MACHINE**

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Complete with Dividing Head and Vertical  
Milling Attachment.

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CAPSTAN LATHE—BAR FEED**

'Flamard' Bed. Speeds up to 750 r.p.m.

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SEMI AUTOMATIC, HYDRAULIC  
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**DELIVERY 14 DAYS****CRAIG & DONALD  
DOUBLE ENDED STEEL PLATE  
FRAME GEARED  
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CROPPING MACHINE**

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Our stock includes Myford MG12 Grinders, Eagle Surface Grinders, Myford Lathes, Boxford AUD 4½ in. Lathes, Willson 4½ in. Lathes, Pacara Drilling Machines from ½ in. to 1½ in. capacity, Startrite Bandsaws, Kennedy, Rapidor and Q. & S. Hacksaw Machines, Centec Milling Machines, 18 in. Alfa Shapers, Vices and Rotary Tables of all types.

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Heated Stoving Oven for sale. Oven inside 5ft. 4in. wide × 13ft. 8in. deep × 6ft. 4in. high, floor 10in. high. Thermometer 50 deg. to 650 deg. F. Auto. temp. control. Six burners. Double door.—Full det. from F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3.

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**ELLIOTT VICTORIA** Juniomill.  
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**VICTORIA** U2 mill.  
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**SUPERALPHA** 6in. by 40in. lathe.

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25 Ton Clyde, 21ft. 9in. span cab control, 1954. Can convert any span to 95ft.  
20 Ton Vaughan, 42ft. 3in. span. Unused.  
20 Ton Morris Goliath, 35ft. span, 5 ton auxiliary.  
10 Ton Heywood, 34ft. span. Unused.  
10 Ton Morris, 32ft. 10in. span, cab control.  
10 Ton, 60ft. span. 1955. (Two.)  
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5 Ton, 37ft. span. 1944.  
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**GOORLEY & EDLAND** Production Mill, 24in. × 7½ in., 400/3/50. £60.

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Classified Advertisements (PLANT FOR SALE, contd.)

# Cashmores

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### CENTRE LATHES

MITCHELL 7in. S.S. & S.C. All-Geared Head Gap Bed Lathe, to admit 3ft. 0in. between centres.  
WILLSON 7½in. S.S. & S.C. Lathe, to admit 3ft. 0in. between centres.  
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VOLMAN 8in. S.S. & S.C. Gap Bed Lathe, to admit 4ft. 6in. between centres.

### BORING MACHINE

WEBSTER & BENNETT 48in. Vertical Boring Mill, table speeds 4-88 r.p.m.

### DRILLING MACHINE

RICHMOND SR1 36in. Sensitive Radial Drilling Machine.

### GRINDING MACHINES

JONES & SHIPMAN Fig. 540 Horizontal Spindle Surface Grinding Machine, hydraulic feed, 6in. x 18in. capacity.  
One similar Machine with vertical spindle.  
NORTON 6in. x 18in. Horizontal Spindle Surface Grinding Machine with hydraulic feed.  
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NORTON 6in. x 30in. Hydraulic Plain Cylindrical Grinding Machine, maximum wheel diameter 20in.

### MILLING MACHINES

VICTORIA M.2 Universal Milling Machine, 40in. x 10in. table.  
ARCHDALE 20in. Dial Type Horizontal Milling Machine, 40in. x 12in. table.  
GREENWOOD & BATLEY Plain Horizontal Milling Machine, working surface of table 20in. by 10in.  
EDGWICK 18in. Horizontal Plain Production Milling Machine, with 40in. x 12in. table.  
EDGWICK No. 2 Dial Type Vertical Milling Machine, 40in. x 11in. table.

### PLANING MACHINE

SWIFT SUMMERSKILL 8ft. x 4ft. x 4ft. Planing Machine with 4 toolboxes, all electric Lancashire Drive.

### POWER HAMMER

MASSEY 5 cwt. Pneumatic Side Type Power Hammer.

### SLOTING MACHINES

BUTLER 14in. stroke All Geared Slotting Machine with 39in. diameter rotary table.  
DUTRANNOIT 24in. stroke Precision Slotting Machine with swivelling head, 39in. table.

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BRONX 8ft. 0in. x 4in. Straightening Rolls, 5 roll type.

All the above machines are motorised 400-440/3/50 cycles.

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# K.E.N.T

## AUTOMATICS

C.V.A. No. 26. 1960 Machine.  
C.V.A. No. 12. 1960 Machine.  
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B.S.A. 2in.

## LATHES

Broadbent 14in. x 7ft., unused.  
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D.S. & G. 18in. x 12ft. S. & S.  
Betts Bridgeford 15in. x 18ft.  
Lang 6½in. x 3ft. S.S. & S.C.  
Holbrook 6½in. x 4ft. Gap bed.

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Sant Andrea U.F.O.3 Hor.  
57in. x 14in., as new.  
Archdale 20in. Hor. Rapid.  
Reinecker Vert. 52in. x 24in. with built in cir. table, 30in.  
Jason Vert. 48in. x 12in. Sw. and Sl.  
Herbert 15s Vert. 48in. x 12in.  
Adams No. 5 Thread Mill.

## CAPSTANS AND TURRETS

Minganti la Turret, 2½in. Bar.  
Gisholt No. 3 Capstan.  
Warner & Swasey No. 3 Capstan.  
Ward No. 2a Capstan Lathe.  
Herbert 15 Capstan Lathe.  
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B. & S. No. 2 Surface Grinder.  
Excel No. 1 Surface Grinder.  
C.V.A. 10 Die Press.  
Maiden Bar-ending Machine.  
Raborn 4ft. 6in. Radial Drill.  
K. & W. 2in. Pillar Drill.  
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All motorised 440/3/50.

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Univ. Grinder. Internal spindle. Motorised work head.—LEE 6183.

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U.S.A. for sale. 1950 model, unused. Capacity 1½in. diameter in 1½in. plate.—BOX C20, MACHINERY, Clifton House, Euston Road, N.W.1.

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BROWN & SHARPE No. 2 18 x 6 Surface.  
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SPRINGFIELD 14in. Swing F. & B. Lathe. £225

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CENTEC No. 3R Auto-cycle, p/o mill.  
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ADCOCK & SHIPLEY 1VM Vert. 25in. x 7in. As new.  
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**VICTORIA** U3 Univ. Miller, 1953.  
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**BROWN & WARD** 8in. and 14in. Autos.  
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**WARD** 2A and 3A Capstans.  
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**FIVE UNION** 2in. Pedestal Drills (New).  
**VICTORIA** V2 Swiv. Head Mill (1954).  
**BULLARD** 16in. sq. Mult-Au-Matic.  
**GLEASON** 12in. Bevel Gear Gen. (1945).  
**FELLOWS** 61A, 64S A Gear Shapers.  
**BRYANT** 16-38 Internal Grinder.  
**HEMAN-FROUDE** Baling Press (1947).  
**SCHULER** Vertical Dieing Press.  
**REDMAN** 12 x 4 x 4 Planer.  
**HERBERT** 9S Turret Lathe.  
**MILWAUKEE** 2H, 2K, 3H, 3K Millers.  
**BLISS** 304A 50 ton Press, 4in. stroke.  
**POLLARD** 28in. Prod. Drill, 5 M.T.  
**NORTON** 14 x 72 Univ. Grinder.  
**BROWN & SHARPE** No. 3 Univ. Grinder.  
**DEFIANCE** 25A Horizontal Borer.  
**ARCHDALE** 35in. Sene. Radial Drill.  
**CHURCHILL-REDMAN** 11 x 60 Gap Lathe.  
**NEWALL** type L 10 x 24 Grinder (1942).  
**BUTLER** 8in. Toolroom Slotter.  
**FLAVER** Horiz. Borer, 31in. spindle.  
**HEAD** 72A Internal Grinder (3).  
**NORTON** 12 x 36 Universal Grinder.  
**WARNER & SWASEY** 3, 5 and 2A Turrets.  
**BROWN & SHARPE** No. 3 Vert. Mill (1942).  
**PEATT-WHITNEY** 12B 2-sp. Profiler (1941).  
**EDGWICK** No. 2 Universal Miller.  
**BARNES** No. 2 Horizontal Hones (3).  
**CHURCHILL** No. 1 Planetary Grinder.  
**OBSCUTT** HM24 Gear Grinder (1944).  
**RYDER** WILLIAM Horiz. Borer, 3in. sp.  
**GIBBOLT** 4, 5 and 11 Turret Lathes, 1941-43.  
**GRIDLEY** Model R, 24in. cap., 4 sp. Auto.  
**ARCHDALE** 30in. Vert. Mill, 1942.  
**CINCINNATI** 2MH Plain Mill.  
**MONARCE** Copying Lathe, 1946.  
**CHURCHILL** PBH 12 x 36 Univ. Grinders.  
 All modern fully motorised machines.

**J. B. MACHINE TOOL CO., LTD.,**  
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 AND AT WOLVERHAMPTON.

### USED MACHINES EX STOCK

**HERBERT** No. 7 Junior Combination  
 Turret Lathe, chucking machine with  
 extensive range of equipment, speed  
 range 30 to 750 r.p.m. Excellent condition.  
**VICTORIA** P2 Horizontal Mill, table 45in. x  
 11in. 1959 machine in first class condition.  
**SOMUA** Horizontal Milling Machine, table  
 67in. x 14in., spindle speeds 32 to 1,250  
 r.p.m. No. 50 I.T. 18 feeds 1/4in. to  
 10 1/4in. per min., power feeds and rapid  
 traverse in all directions. 1965 machine.  
**LE BLOND** Lathe, 18in. swing x 9ft.  
 between A.G.H. 8.5, & B.C. Speeds  
 15 to 522, double vee straight bed.  
**CINCINNATI** Plain Hydromatic Mill 3/36,  
 speeds 27 to 200 r.p.m., power rapid  
 traverse with auto cycle.  
**AQUITH** OD1 4ft. 6in. Radial Drill, 2  
 speeds 58 to 1,560 r.p.m. No. 5 M.T.  
 2 motors, power rise and fall, power feed  
 spindle, loose box table.

All machines motorised 415/50.

**A. LAWRENCE & CO.,**  
 (MACHINE TOOLS) LTD.,  
 WILSH HARP, EDGWARE ROAD,  
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**GRANOR OF HALIFAX** 28in. stroke Heavy  
 Duty Shaping Machine. 400-440/3/50.

#### EARLY DELIVERY

**MITCHELL OF KEIGHLEY** 8 1/2in. Type  
 DMB Gap Bed Lathe, by 5ft. 3in. B.C.  
 400-440/3/50. Instant delivery.  
**MITCHELL OF KEIGHLEY** 10 1/2in. Type  
 DM10 Gap Bed Lathe by 5ft. 3in. between  
 centres. 400-440/3/50. Instant delivery.  
**MITCHELL OF KEIGHLEY** 12 1/2in. Type  
 DM12 Gap Bed Lathe by 6ft. 3in. B.C.  
 400-440/3/50. April delivery.  
**VICTORIA** No. 2 Rapidmill Universal Milling  
 Machine, table size 45in. x 11in.  
 400-440/3/50. Instant delivery.  
**VICTORIA** No. V2 Vertical Milling Machine.  
 Table size 45in. x 11in. 400-440/3/50.  
 Instant delivery.

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**Micromatic Hydrohoner**  
 Hydraulic Honer. Model H1 Auto cycle.  
 Table 14 1/2in. x 10in. W/S. Ind. Motors.—  
 WILCOX & CO., Barr Street, Birmingham, 19  
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 (1956).  
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 Cylindrical Grinder.  
**HARRISON** 4 1/2in. Lathe with equipment,  
 1944 Machine, in good condition.  
**MORARA** CAF-200 Gap Gauge Grinder.  
 Nearly New Condition.  
**SPEEDAX** 20in. Bandsaw with Brazing  
 Attachment. 1957 Machine.  
**D.G.G.** 18 1/2 Lathe with equipment.  
**ARBOGA** 1in. cap. Radial Arm Drill,  
 20in. dia. 1957 Machine.  
**EXCEL** No. 3 Filing and Sawing Machine.  
**HERBERT** Junior Surface Grinder.

#### NEW

**STANLEY** 8 1/2in. Lathe, 6ft. between centres.  
**VICTORIA** 0.2 Omnium.  
**RICHMOND** No. 3 Vertical Milling Machine.  
**RICHMOND** SR2 1 1/2in. cap. 36in. Radial  
 Drill.  
**INVICTA** Major 30in. Shaper, with swivel  
 table and auto down feed.  
**ALBA** 6S 24in. Shaper.  
**INVICTA** 6M 24in. Shaper.  
**STARTATE** Sabre 20in. Throat Bandsaw.  
**Q. & S.** 8in. cap. Power Hackaw.  
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 Grinder.  
**"AUERBRACH"** Hand Lever Horizontal  
 Milling Machine, table size 16in. x 5in.  
**"ELB"** 24in. x 12in. Hydraulic Horizontal  
 Spindle Surface Grinder.  
**"UNION"** Carbide Tool Lapping and Chip-  
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**"FREDDY"** Punching and Shearing Machine,  
 cuts Flats 4in. x 1/2in., Angles 2 1/2in. x  
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 Grinding Machine, 10in. by  
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 Universal Grinder. Internal Attachment.  
 New condition

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 x 4ft. 0in.; and 10ft. 0in. x 3ft. 0in.  
 Marking Off Tables for sale. Accurately  
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MOPCO 39in. x 11in. Hydraulic Surface  
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NORTON 14in. x 36in. Universal.  
NEWALL 10U Universal Lapper.**CAPSTAN AND TURRET LATHES**GISHOLT 1L Turret Lathe.  
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VAN NORMAN Plain Mill.  
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CINCINNATI Mod. 08 Vertical Mill.CENTEC No. 2 Milling M/c.  
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CINCINNATI HYDROTEL 28in. Vertica  
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MOREY 12M 2 Sp. Profiler.  
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KITCHEN & WADE No. 2 Honing Machine.  
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H.M.E. Model L.6 Power Presses (6 ton cap.).  
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FELLOWS 75A High Speed Gear Shaper.  
FELLOWS 61A Gear Shaper.  
HEALD 72A3 Internal Grinder.  
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Richards Vert. Borer, 6ft. 4in.  
swing, 2 swivelling tool heads. Motorised.  
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Lapointe V.3 Vertical Broach.  
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Classified Advertisements (PLANT FOR SALE, contd.)

## F.J. Edwards Ltd

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**CHURCHILL** 16in. x 36in. Universal Tool and Cutter Grinder.  
**CHURCHILL** 12in. x 36in. Hydraulic Universal Grinding Machine, with internal spindle.  
**BROWN & SHARPE** 12in. x 36in. Universal Grinding Machine.  
**CHURCHILL** 18in. x 6in. Model O Universal Tool and Cutter Grinding Machine.  
**CHURCHILL** 8in. x 16in. Model O Semi-Universal Grinding Machine.  
**BILLETTER** twin head Radial Arm Open Sided Hydraulic Slideaway Grinder. Table 9ft. 8in. x 2ft. 3in., infinitely variable table speeds 6ft. 6in. to 38ft. per min., push button control, rapid traverses, telescopic bed covers.  
**NORTON** 10in. x 36in. Hydraulic Plain Grinder.  
**CHURCHILL** 24in. x 6in. Horizontal Spindle Surface Grinding Machine.  
**SNOW** type NC14 Horizontal Surface Grinding Machine, 12ft. stroke, with casting table for shear blades, etc., fitted with 12ft. 6in. x 8in. magnetic chuck.  
**SUPERIOR** Horizontal Surface Grinder, 15in. x 5in., hand feed. (New.)  
**BROWN & SHARPE** 18in. x 6in. Horizontal Surface Grinding Machine.  
**COVEL** 24in. x 8in. Hydraulic Horizontal Surface Grinder.  
**JUNG** 15in. x 6in. Hydraulic Horizontal Surface Grinder.  
**WRIGHT** 12in. Table Surface Grinder. (New.)  
**GRAND RAPIDS** No. 25 Hydraulic Spindle Surface Grinders, 18in. x 6in. table, 20in. table traverse.  
**NORTON** 6in. x 10in. x 36in. Hydraulic Open-side Surface Grinder.  
**HEALD** No. 72 Size-Matic Duplex Hydraulic Internal Grinder, for finish grinding opposite holes.  
**SMART & BROWN** 14in. cap. Internal Grinder.  
**BRYANT** 16-38A Hydraulic Internal Grinder.  
**CINCINNATI** 6in. x 18in. Model EA Hydraulic Cylindrical Grinder.  
**CHURCHILL** Model HBB automatic slazing traverse feed type Internal Grinding Machine, with spindles for combined hole and face grinding, max. swing 19in.  
**FRATT & WHITNEY** 36in. x 12in. Vertical Spindle Surface Grinder.  
**HUNT** No. 3 Twist Drill Grinder, 3in. cap.  
**HUNT** No. 1 Twist Drill Grinder, 4in. cap.  
**BANDFACERS**, 43in. x 6in., and 36in. x 4in. (New.)

### MILLING MACHINES

**CINCINNATI** 0-8 Vertical Miller, 20in. x 6in.; 150-1,300 r.p.m.  
**ADCOCK & SHIPLEY** No. 2 VP Vertical-Production Milling Machine, table 30in. x 10in. capacity 22in. x 8in. x 18in., speed 750-1,500 r.p.m.  
**ARCHDALE** 12in. light type high speed Vertical Milling Machine, table 17in. x 10in., 12in. traverse, speed 235-1,500 r.p.m.  
**B.C.A.** Precision Vertical Milling, Boring and Drilling Machine, 8in. dia. table.  
**HERBERT** 46V Vertical Milling Machine, capacity 36in. x 13in. x 22in., table 88in. x 15in.; power rapid all ways.  
**REED PRENTICE** No. 5 Vertical Milling Machine, tableless type; capacity 48in. x 16in. x 15in., table 66in. x 16in., speed 17-600 r.p.m.  
**REED PRENTICE** No. 5 Vertical Milling and Diecasting Machine as above, with power feed to spindle.  
**VAN NORMAN** No. 38U Universal Miller; 64in. x 14in.; capacity 34in. x 12in. x 17in. 25-1,250 r.p.m.; 1955 machine.  
**VICTORIA** U.1 Universal Miller, table 40in. x 11in., capacity 25in. x 8in. x 16in., speeds 31 to 1,010.  
**VICTORIA** U.1 Universal Miller, table 40in. x 11in., capacity 25in. x 8in. x 16in., speeds 31 to 1,010; with vertical milling attachment.  
**VICTORIA** U2 Universal Miller, table 46in. x 10in., capacity 31in. x 9in. x 13in.  
**PROGRESS** Universal Milling Machine, table 40in. x 10in., capacity 24in. x 9in. x 18in.  
**FEDERSEN** Horizontal Miller; table 49in. x 10in., capacity 24in. x 7in. x 16in.  
**EDGWICK** No. 1 SIMPLIMILL Horizontal Production Milling Machine, table 18in. x 5in., capacity 10in. x 3ft. x 13in., speeds 60-540 r.p.m.

359-361, EUSTON RD., LONDON, N.W.1  
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TRIUMPH & STUDENT LATHES**  
**WILLSON** Mk. V lathes.  
**KERRY AG2 5½** lathes.  
**MYFORD** Super 7 lathes.  
**DENBIGH** D4 milling machines.  
**VICTORIA** U2 rapidmil.  
**PROGRESS** 3A pillar drill.  
**G & S** 6in. and 8in. hacksaws.

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 lathe, also one Thiel punch shaper.—BOX  
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79in. x 23in. x 28in. Machined short ends and two opposite sides. Other two sides open. Ends have 1in. diameter holes, sides have slots 8in. x 2in. and 3in. x 2in. Well ribbed. Photo—F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3.

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**CONOMATIC** 1ft. 8 spindle. Type W.W.

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**KEARNS** No. 2 Boring and Facing.

### DRELLING

**ASQUITH** 4ft. 6in. O.D.1 Radial Drill.  
**PROGRESS** 5E. Round table

### GEAR SHAPING

**Model 61 FELLOWS** Gear Shaper, 1942.  
 Straight spur, 35in. dia. x 5in. face width.

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**MONARCH** 22M S.S. & Taper Turning Lathe.  
**WARD** 10ft. Combination Turret Lathe.  
**WARNER & SWASEY** No. 2A Long. bed.  
**SOUTHBEND** 16in.  
**EDGWICK** 7in.  
**DEAN, SMITH & GRACE.** Height of centre 7in.  
**WARNER & SWASEY** No. 6 Presselector.

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**KENDALL & GENT** C.V.M. 40. In good condition.  
 20in. **ARCHDALE** Plain Mill. Rapid.  
 18in. **EDGWICK** Production Mill.  
 16in. **MILWAUKEE** 2E Plain.

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24in. **CHURCHILL REIDMAN** Heavy Duty.  
 19in. **TOWN** Heavy Duty.

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**EDWARDS** 6ft. x 4in. Overcrank.  
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**MORGAN** 6ft. x 14g. Universal.  
**EDWARDS** 6ft. x 4in. Swing beam, hand geared.  
**EDWARDS** 6ft. x 14g. Open ended.  
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 6ft. x 12g. between columns. Delivery 10 weeks.  
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 All machines motorised 400/3/50 cycles.

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**LE BLOND** 15R.P. S. & S. 15in. x 24in.  
**CARDIFF** S.S. & S.C. 8ft. x 48in. "Senior."  
 1952 M/c.  
**CRAYEN** 36in. Swing x 12ft. Between S.S. & S.C.  
**SMART & BROWN** 4in. x 18in. S.S. & S.C.  
**SWIFT** 12in. x 12ft. S.S. & S.C. Heavy Duty R/trav. to saddle.  
**LANG** 36in. Surfacing and Boring.  
**ACME** No. 5W Capstan, chuck machine.  
**RYDERMATIC** No. 12 Multi-Tool.  
**D.S.G.** 13Z Minor S.S. & S.C.  
**WILLSON** 6in. x 36in. Gap Bed S.S. & S.C.

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**WARD** No. 7 (Curran Sub-Contract).  
**TAYLOR** No. 1263 Capstan, 4in. cap.

### DRELLS

**GRIMSTON ELECTREKA** Model EB100 Bench.  
**CORONA** Model 9FX Super High Speed Bench.  
**CORONA** Model 12AX Bench, 4in. cap.  
**BRISDON** Model 62 Pillar, 4in. cap.

### GRINDERS

**KEIGHLEY KN** Internal.  
**GRAND RAPIDS** No. 35 Hyd. Hor. Spin. Surface.  
**HERBERT JUNIOR** Surface, 10in. x 6in. x 9in.

**BROWN & SHARPE** No. 5 Surface.  
**BROWN & SHARPE** No. 23 Plain, cap. 10in. x 48in.  
**BROWN & SHARPE** No. 2 Surface, cap. 6in. x 18in.

**SMART & BROWN** Internal, 14in. cap.  
**BROWN & SHARPE** No. 5, 3in. x 18in. Plain.

**BALLINGER** 10/24 "Versatile" Abrasive Cutting-off Machine.  
**TURNER T.T.** 14/20 d/ended Tool.

**NEWALL** Model L.U. 10in. x 36in. Hyd. Universal.  
**B.S.A. LANDIS** Type C 6in. x 18in. Hyd. Plain.

**SNOW** Mod. O.S.72 Surface, cap. 15in. x 72in.  
**CHURCHILL** Mod. H.C.B. Internal Auto Size.

**HAHN & KOLB** Hyd. Disc Lapping M/c.  
**JACKMAN** No. 22 Disc, 18in. dia.  
**LUMSDEN** Model 12M Tool, 14in. x 2 wheel.

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**REED PRENTICE** Mod. 3VG, table 38in. x 10in.  
**DENBIGH** No. C4. Swivel table 46in. x 10in.  
**CINCINNATI** Model OS Production.  
**KENDALL & GENT** Duplex Profile, table 18in. x 15in.

### MILLERS—Horizontal

**BROWN & SHARPE** No. 000 Plain Auto Miller.  
**CENTEC** No. 2A with vert. attachment.  
**BROWN & SHARPE** No. 2 Universal, light type.

**ADCOCK & SHIPLEY** No. 1AB Plain, table 26in. x 7in.  
**RICHMOND** 2HS Plain, table 35in. x 9in.

**ARCHDALE** 20in., table 40in. x 10in.  
**ASQUITH** H.S.1 Duplex Keyway, table 43in. x 10in.

**CINCINNATI** Mod. O.K. Prod., table 34in. x 12in.  
**ARCHDALE** 14in. Plain, table 27in. x 8in.

**ARCHDALE** 28in. Plain, table 49in. x 13in.

### BORING MACHINE

**KEARNS** Mod. O.C. Horizontal, 3in. dia. spindle.

### SLOTTERS

**RICHMOND** 4in. Stroke (Unused). Two machines.

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**HERBERT** N.D. 20in.  
**ORMEROD** 14in.

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**MAXICUT** Gear Shaper, Mod. No. 2.

### MISCELLANEOUS

**HEAP** 2in. Screwing Machine.

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# R. O. GRAY

**CLEVELAND** Model "A" Single Spindle Automatic. Capacity 4½ in. dia. bar.

**MAGERLE** F.10 Horizontal Surface Grinder, hydraulic. Table W.S. 41½ in. by 9¾ in., with Barnesdrill Magnetic Coolant Separator.

**DISKUS** Vertical Spindle Surface Grinder. Table 53 in. by 10 in. Hydraulic feeds, 12 in. dia. segmental wheel.

**CHURCHILL** Model "O" Universal Tool and Cutter Grinder, 8 in. by 16 in.

**JONES & SHIPMAN** 310 Tool and Cutter Grinder, 8 in. by 16 in.

**MATRIX** No. 10 Thread Grinder, with crushing attachment.

**BROWN & SHARPE** No. 2 Universal Milling Machine. Table W.S. 46 in. by 10 in. Spindle speeds 30-1,300 r.p.m. Vertical attachment, slotting attachment, universal dividing head, rotary table, etc.

**CINCINNATI** 0-8 Vertical Milling Machine. Table W.S. 20 in. by 6 in. Spindle speeds 150 to 1,300 r.p.m.

**THREE HERBERT** O.V. Vertical Milling Machines, swivel head. Table W.S. 18 in. by 5 in. Spindle speeds 250-2,000 r.p.m.

**ARCHDALE** 28 in. Plain Horizontal Milling Machine. Table W.S. 49 in. by 13 in. Power feeds and rapid traverse.

18 in. **EDGWICK** Plain Horizontal Milling Machine. Table W.S. 26 in. by 7 in.

**PALLAS** H.O. Plain Horizontal Milling Machine. Hand lever feed. Table W.S. 16 in. by 5 in.

**TRIDENT** V.O. Swivel Head Vertical Milling Machine, table W.S. 30 in. by 8 in.

**DRUMMOND** Model K Capstan Lathe, arranged for chucking. 2½ in. Hollow Spindle.

**GISHOLT** No. 4 Capstan Lathe, arranged for chucking, 2½ in. Hollow spindle.

**TURNER** 1½ in. Capstan Lathe, with bar feed.

**TWO HERBERT** No. 2B Capstan Lathes, one with bar feed, one arranged for chucking.

**HERBERT** No. 1S Capstan Lathe, chucking.

**KITCHEN & WADE** Heavy Duty Vertical Drill. Spindle bored No. 4 M.T. 24 in. dia. rise and fall table, swings round column.

**TWO HILLE** two-spindle drilling machines. Power feed and independent motor to each spindle, fitted ¾ in. drill chuck. W.S. Table 21½ in. by 9 in.

**ARCHDALE** 6 ft. Radial Drill, No. 5 M.T. Tee slotted low base 4 ft. by 6 ft.

**ARCHDALE** 5 ft. Radial Drill No. 5 M.T. Tee slotted low base 4 ft. by 6 ft.

**THIEL** No. 6 Radial Arm Tapping Machine, ¾ in. Whit.

**SUPERIOR** Vertical Tapping Machine, ¾ in. Whit.

**HERBERT** No. 2 Flash Tapper.

**ALBA** 18 in. Crank Shaping Machine.

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**EVERY** Dynamic Balancing Machine, 220-lbs.

**DEAN, SMITH & GRACE** 24 in. Swing Boring and Surfacing Lathe, 3 in. Hollow Spindle. Hexagon turret on compound slide rest.

**CHURCHILL-CUB** 5 in. Lathe. Admits 24 in. between centres.

**GLASS** 9½ in. by 10 ft. 6 in. S.S. & S.C. Gap Bed Lathe. 2½ in. Hollow Spindle, swing in gap 30 in. dia. Admits 6 ft. 6 in. between centres.

**COLCHESTER** 7½ in. by 7 ft. SS and SC Gap Bed Lathe. 1½ in. Hollow spindle, swing in gap 24 in. dia.

**TWO COULTER** Vertical Spindle Fine Boring Machines.

**PEARNE-RICHARDS** No. 2 Horizontal Boring and Facing Machine. Dia. of facing head 20 in. With vernier height gauge and boring bars.

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All machines self-contained drive. 400/440 volts, 3 phase, 50 cycles.

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## QUALITY USED MACHINE TOOLS IN STOCK

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Classified Advertisements (SITUATIONS VACANT, contd.)

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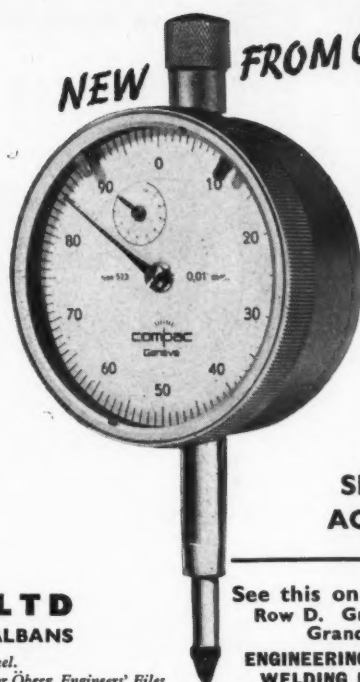
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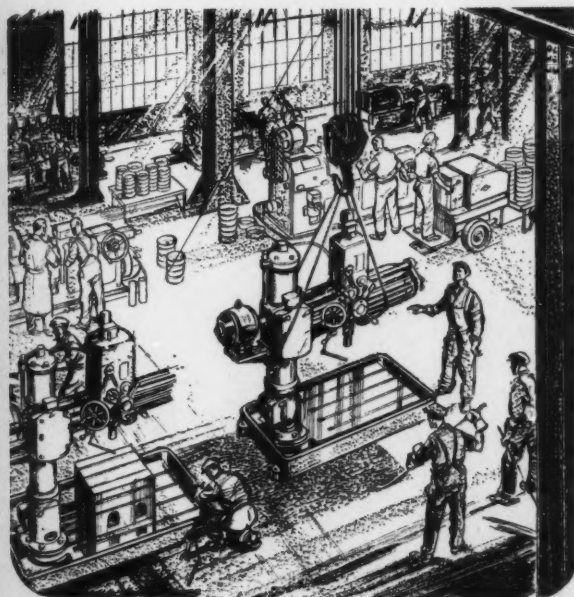
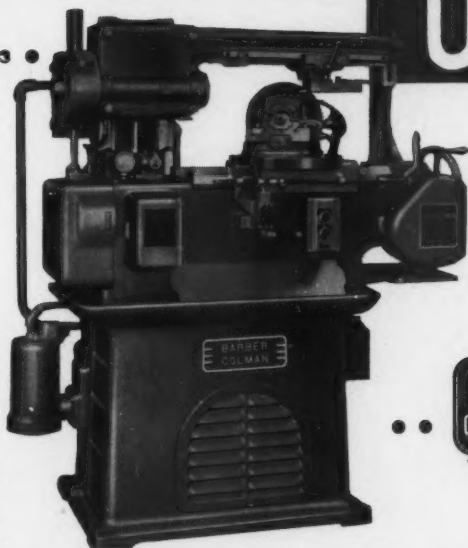
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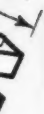
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